EDITORIAL

ONE of the many notable exhibits to be displayed at the Panama-Pacific Exposition is that of the United States Steel Products Company. The exhibit, which has already been received on the ground, will occupy three-quarters of an acre in the Palace of Mines and Metallurgy, and consists principally of models of factories and mills. The hygienic and 'safety first' features of factory arrangement and design, in which the Steel Corporation has done notable work, will be especially emphasized.

IT is the common impression that we must rely upon the universities and government bureaus for research and experimental work in engineering investigation. Mr. Grunsky's paper on 'Determination of the Maximum Storm-Water Flow,' printed in this issue, is the exception that proves the rule, as it is indeed seldom that an engineer of established practice will give to his fellows the result of his experience. The subject itself is big, especially in California, where so many large projects under way and in contemplation involve storm-water flow determinations. The application of the Grunsky formula in conjunction with tabulated data available through the activity of the Geological Survey will be of great assistance to engineers engaged in work of this character, and we take this occasion to express our appreciation for the privilege of making these data public.

WHETHER one admires or dislikes the Germans or preserves a strict neutrality, all agree that as a nation they have attained remarkable efficiency in war, in industry, and in many other departments. It is generally conceded that this efficiency is very largely due to the semi-military organization of most lines of activity. It is a truism that concentration of responsibility is one of the prime requisites for efficiency. Many evidences are accumulating that a recognition of this fact is penetrating into political circles. One of the most recent manifestations of the general movement toward concentrated responsibility is the 'City Manager' plan. In most small towns and cities, all the officers are men engaged in other occupations, who devote part of their time and seldom their best efforts to the city's business, and are paid nominal salaries, fees, or nothing at all. To substitute for these men, one City Manager who would devote his whole time at an adequate salary to superintending the city's business and directing, as well as 'hiring and firing' the city's employees, was found by a number of small communities to result in increased efficiency and economy. Now the advantages of concentrated responsibility are beginning to be appreciated by the larger cities.

WE take pleasure in announcing that Mr. A. T. Parsons has joined the staff of *Western Engineering* as assistant editor. Mr. Parsons was graduated in civil engineering from Stanford University in 1904 with the degree of A.B. Since that time, his work has been chiefly in the irrigation, reclamation, railway, and petroleum production fields. Our readers will recall the contributions from Mr. Parsons' pen dealing with various phases of petroleum technology, which, in themselves, serve better than a formal introduction. In furtherance of our general policy to better constantly what we are pleased to term 'Western Engineering Service,' Mr. H. L. Quigley has left for Seattle, where he will undertake to increase the usefulness of *Western Engineering* in the Pacific Northwest. The time seems ripe for extensions. We have been preaching optimistically regarding our belief in the great future of the Pacific Coast, and in the extensions and betterments made during the past six months within our own field of endeavor may be found an expression of the courage of this belief.

THE Lake Spaulding power project of the Pacific Gas & Electric Company has been a frequent topic of discussion in the technical press, and to some it would appear that as a subject it had almost been exhausted. Nevertheless, there is a phase of the work which, as far as we know, has not until this issue been touched upon, and that is the design and construction of the hydraulic prime movers. Mr. J. W. Swaren's paper covers more especially the generating set for Powerhouse No. 5, the turbine itself being the largest of the single-discharge type ever built. The problems involved in the design and construction of a piece of apparatus of this size and character are many and complex, while the conditions under which the very heart, as it were, of an electric power and lighting company must operate are such that much more than mere human intelligence must be shown by the apparatus in order that service may be uniform under wide fluctuations of load. Apparatus of this character has reached a high state of development, and while the impulse wheel invented by the late Lester A. Pelton was developed and perfected in California, it is interesting to note that the turbine in question is also a product of this state.

THE vacancy on the Railroad Commission of California resulting from Mr. John M. Eshleman's election as Lieutenant Governor, together with the creation of the State Water Commission, brings up anew the question of representation for the engineering profession on public utility and other commissions. In the past, neither the people nor their representatives in high executive positions have taken kindly to this idea.

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It will be remembered that not long ago a committee from the American Institute of Consulting Engineers journeyed to the White House to advocate the appointment of an engineer to fill a vacancy on the Interstate Commerce Commission, and was received with civility, but nothing more. At first sight such appointments appear to have everything in their favor. Public utility and other commissions deal very largely with matters of engineering, and their decisions on such questions have not always been wise. An engineer member of such commissions would be of material help to his colleagues in bringing about a correct understanding of technical points involved. One drawback to such an appointment would be the possibility that the engineer member of the commission would become in time the commission's actual chief engineer, reducing the nominal chief engineer to a mere figurehead. The low salaries usually paid for such positions render them unattractive enough at best, and with this added handicap, it would be difficult to get even a second-class man to undertake the work. The consequences, in case the engineer on the commission happened to be a 'political appointee,' would be serious. A still more important consideration is the tendency of the expert in any department to magnify the importance of matters in that department. This is unobjectionable in a witness giving testimony, but it is a decided disqualification in the case of the man who, acting in a judicial capacity, must decide what weight is to be given to that testimony. It would seem that the ideal public utilities commission should be composed of men of breadth of experience and judgment, authorized to employ the advice of the most eminent experts in engineering, law, finance, or any other line of activity. An engineer as such should not be disqualified for membership on such a commission, any more than a lawyer, but it is not necessarily an occasion for regret if the commission has no engineer members. The interests of the public and of the engineering profession would alike be better served through the payment of sufficient salaries to engineers employed by the commission to insure obtaining first-class men than by a nominal recognition of the profession in the personnel of the commission itself.

The Engineer as a Man of Affairs

In our issue for November last, we took occasion to comment editorially on the method of selecting county and city engineers. Our attention has been directed to the fact that for two years all county officials in California have been nominated without reference to the party affiliations of the candidates, and that the party now in power is pledged to effect the same reform with respect to state offices. Nevertheless, the usual office-seeking tactics must necessarily be resorted to in order to obtain a place on the ballot, both at the primary and general elections, and therefore the better engineer is not at all unlikely to go down in defeat before the better politician. It is the common failing of the 'good' American citizen to stay at home on election day while the 'gang' goes to the polls. The voters as a whole are not competent to pass upon the qualifications of a candidate for county surveyor, for instance, especially in the larger communities. Our plea more especially was for the selection of an engineer for public office by a 'jury of his peers,' just as candidates for the judiciary are passed upon by the bar association.

Engineers as a class have a pronounced tendency to hold themselves aloof not only from politics, but the larger field of business affairs as well. For this reason, engineers voluntarily exclude themselves from the larger opportunities of this life and the recognition to which their learning justly entitles them. To the layman, the engineer is a be-spectacled person in laced boots, whose discourse consists principally of words of which he alone knows the meaning. To the engineer, the business man has no God but the dollar, and a bump of acquisitiveness developed to such an extent that all other considerations are subordinate. Both are wrong. The engineer is human, just as other men, and the business man of today has a conscience and a desire to render a fair equivalent for every dollar received. A better acquaintance and understanding between business men and engineers is needed, and would be of great benefit to both.

Why should the engineer not take a more active part in the affairs of the State and Nation? True, this is contrary to the unwritten law governing the conduct of the national engineering societies, and of the majority of engineers as individuals. As a result, in the conduct of affairs the engineer plays a subordinate part. He reports to the 'general manager,' a business man, whose compensation is often many times that of the engineer who designs the work, executes it, and then operates it when completed.

This isolation may be sublime, if there is any satisfaction to the engineer in that, but it cannot be gainsaid that the field of independent practice is becoming more and more narrowed all the time until by far the great majority of engineers are making a living by occupying a place, more or less subordinate, on the payroll of some corporation, thereby placing the engineering work of today under the control of commercial interests.

Will the present policy of frowning down upon a participation in politics result in the upbuilding of the profession? If this is so, what can be done to obtain for the engineer the recognition in the world of affairs to which his knowledge and abilities entitle him? We do not take kindly to the idea that the engineer should always be called upon to 'assist' some one else. Why should not his profession entitle him to recognition as one competent to direct not only in the smaller but also in the larger field of the activities of this life? The engineer seldom starts anything; he derives a living from the things that some one else has already started. Dr. Woods Hutchinson once said that man was an internal combustion engine. The internal combustion engine once had to be cranked by hand. Nowadays they all have self-starters. Engineers should get self-starters.

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REVIEW OF THE MONTH

AT no time for many years has the President's Thanksgiving proclamation had greater significance. Complaints over general business stagnation have little or no meaning compared to the situation in Europe. It is also a pleasure to note the generous response on the part of the citizens of the United States to the plea to aid the stricken Belgian people. Regardless of the direction in which one's personal sympathies lie, what is left of the civilized world cannot do other than bend every energy toward preventing the absolute destruction of a peaceful, industrious nation, which was drawn into a contest against its will, and then only in response to the spirit that actuates any man worthy of the name, to prevent the violation of his own fireside. It is a matter of pride to Westerners, and Californians in particular, that the guiding spirit in the Belgian relief work should be Mr. Herbert C. Hoover, Stanford University graduate, engineer, and Californian, who at great personal sacrifice is devoting himself to this work.

BANKERS for some days past have been telling us that we are on the 'eve' of a great era of prosperity. To some it has seemed that the 'eve' is of the Alaska type, months in duration, and that the dawn after the eve is long overdue. The horizon seems to be lightening, however. Reports from the great manufacturing centres are more encouraging than for many months past. Orders have been reported for enormous quantities of motor trucks, food supplies, steel rails, and shapes. The increased activity in the steel industry is the most hopeful sign, as the purchase, of what may be regarded as munitions of war, benefits a comparatively small class of people, and cannot affect to a marked degree the welfare of the country as a whole. Orders for steel products, however, is another story. Much material of this class has in the past been purchased in England, France, Germany, and Belgium. Now that our competitors for international trade are out of business, we cannot do other than profit thereby. The United States has become the market place of the world. The channels of trade are already seeking new paths.

STATISTICS are dull things, ordinarily, nevertheless recent figures of foreign commerce of the United States are interesting, especially from a Pacific Coast standpoint. Of course, for the country as a whole a great decline is shown for the month of October as compared to the same month in 1913. In the case of California, however, the value of exports is nearly double that for October 1913, the total being $8,990,234 as compared to $5,050,455. This may be taken as an indication of what may be expected to result from the opening of the Panama canal. All of the new cargoes and $3,846,988 of the foreign bound commerce were sent through the canal, England taking over $3,000,000 of the latter figure. Practically all of the material was foodstuffs of various kinds, and included grain, canned and dried fruit, and great quantities of canned salmon. The average is increasing every day. The figures taken from reports of ten ports in the United States for November 18 show a total of $4,977,029, or about $2,000,000 less than the daily average for November 1913. The trade balance for the first half of November shows an excess of exports over imports of $25,758,899.

SECURITY holders of the Northern Electric Railroad, especially the bondholders, have abundant cause to exhibit the true thanksgiving spirit. News that the Santa Fe railroad is to purchase the property is better than turkey, and although various entanglements were brought about by the collapse of the Sloss fortune and the consequent receivership, it is not anticipated that anyone will refuse to accept real money for his bonds on any equitable basis. The funds for the purchase of the Northern Electric railroad will be provided through the sale by the Santa Fe railroad of its half interest in the Northwestern Pacific railroad to the Southern Pacific Company, thus giving exclusive ownership by the latter of this entire system, including the recently completed extension to Eureka.

THESE changes in ownership will involve some interesting readjustments of the railroad map of California. By means of the new connection, the Santa Fe company becomes a factor in the Sacramento valley. This rich territory in the past, outside of comparatively small bay and river competition, has been the exclusive property of the Southern Pacific Company. It perhaps might seem strange that it would be willing to further the entry of so strong a competitor as the Santa Fe company. On the other hand, it is doubtful whether it is generally known how rich a territory has been opened by the Northwestern Pacific extension to Eureka. A vast development through the improved transportation facilities available will undoubtedly take place. The lumber and cattle industries are now for the first time in a position to reach the interior markets. Heretofore the only access to Eureka was by sea. Undoubtedly the exchange that has been made will be of great benefit to both companies as well as to the communities served.

THE bond market is still in the doldrums as far as public utility offerings are concerned, while the demand for the better class of municipal bonds is good. Regulation *ad lib.* is responsible for the lack of enthusiasm where public utility offerings are concerned. The

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large bond brokers and bankers are doing practically nothing, while new development enterprises are hibernating until a better understanding obtains between the various regulating bodies and the promoters. For the same reason the overstock of securities in the vaults of the bankers keeps them from bidding on municipal offerings. Another reason is that underwriters of bond issues oppose municipal operation of public utilities, and will not as a general rule undertake to furnish financial assistance in furthering projects in competition with private enterprise. City officials, however, have hit upon the plan of selling over the counter direct to the purchaser without the assistance of the middle man, and seem to have been successful to a marked degree. San Francisco adopted this plan with respect to the bonds for the Geary Street municipal railroad with marked success, and is following it up with other issues that did not seem to attract bankers. An issue of $1,742,500 advertised for bids on October 26 met with no response. Accordingly the city treasurer proceeded to sell it over the counter, with the result that on November 17 all of the large denomination of 5-per cents were sold, together with a good proportion of the $100 bonds, 'baby' bonds, as they are called. Altogether, nearly $1,400,000 bonds were sold within three weeks. These sales practically exhaust all of the city 5-per cent bonds, so the investing public will have to content itself with the 4½ per cents remaining. In the Pacific Northwest also conditions are improving. An issue of $92,984.92 of municipal bonds has been sold at Portland, while Seattle reports the sale of $829,500 5-per cent bridge bonds after spirited bidding from several investment bankers. The State of California authorized a number of improvement bond issues at the last general election, among them being $1,800,000 for new buildings at the state university; $3,000,000 for state buildings at Sacramento; $1,250,000 for a state building at San Francisco; while two county road bond issues, those for Sonoma and Siskiyou counties were defeated.

WESTERN RAILROADS show no perceptible diminution in preparing for a record development in the West. On November 15, Northern Pacific trains rolled over the Cascade mountains on double tracks for the first time. The section of new road-bed recently completed extends from Easton to Weston, thereby giving continuous double trackage from Tacoma to Stampede tunnel. The latter is the only remaining single track on the Northern Pacific mountain division. Of even greater importance is the announcement of the purchase by the Northern Pacific company of the Gilmore and Hiburg railroad in Montana and Idaho, thereby giving the Company the shortest route from Minneapolis and St. Paul to the Pacific Coast. The Chicago, Milwaukee & St. Paul railroad is also to the forefront with an announcement of electrification of the Rocky Mountain district within the next four years, involving an expenditure of $13,000,000. It is stated that work will be commenced immediately on the electrification of the Puget Sound extension between Avery, Idaho, and Harlowtown, Montana, a distance of 440 miles. A contract has been signed with the General Electric Company involving a preliminary expenditure of $2,000,000 covering the necessary apparatus.

AN order for $4,000,000 of submarines is another indication of better things to come for the iron trades of San Francisco. In this instance, the Union Iron Works of San Francisco is the fortunate contractor, the order having been received through the Electric Boat Company. Let us therefore leave questions of neutrality to those whom it may concern and be thankful for the work.

ELECTRICITY on land bids fair to be rivaled by the application of electricity for transportation on the seas. The United States Navy collier *Jupiter* was the first deep sea going vessel to be equipped with electric propulsion, and the wonderful record of economical application of power made by that vessel has prompted the adoption of the same system for the new superdreadnaught *California*, for which contract has been let to the New York navy yard. There seems to be little doubt that ultimately electric propulsion will displace direct steam, gas, or oil engine drives on all ocean going vessels, while for ferry boats and other vessels, which in the course of their work are frequently started and stopped, the advantages of electricity are even more striking. Central station power, having spread over all the land is now going out to sea, and the battleship or ocean liner of the future will be controlled from the bridge like a trolley car, while the engine room telegraph with its multiplicity of bell calls will be a thing of the past.

PETROLEUM production in California showed a marked falling off in October, which, under the circumstances, is an excellent thing for the industry. The daily average was 282,152 barrels, a decline of about 8000 barrels as compared to September. It is cheaper to store oil in the ground than in tanks or reservoirs, and until our export trade becomes restored to normal conditions, curtailment of production should continue until it more nearly equals consumption. The falling off in shipments has been met courageously by the refiners and marketers, who have been called upon to provide extraordinary additional storage for oil delivered to them under long time contracts. This additional capital investment, while obligatory on their part, is practically unproductive, and when shipments to Europe can be resumed, will represent in itself a practical loss. This loss, however, is more than likely to recoup itself when the European war is over by reason of the inevitable paralysis of the Rumanian and other European fields which will not become a factor in the production of petroleum until long after peace is declared. In the mean-time, producers will have to sit tight, take measures to prevent deterioration of the wells, and wait for the better things to come.

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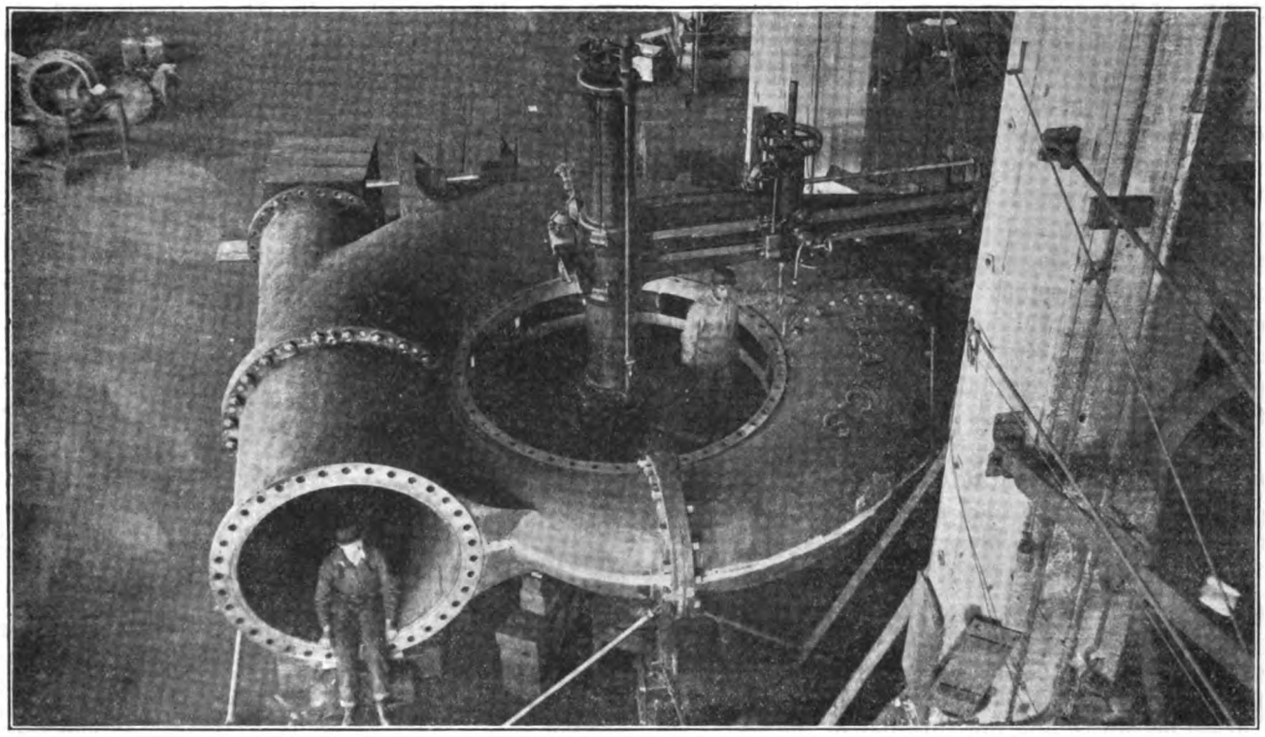

BORING SPIRAL CASING FOR 20,000-KW. TURBINE.

Lake Spaulding Development, Power-House No. 5, Pacific Gas & Electric Company

By J. W. SWAREN*

Lake Spaulding development of the Pacific Gas & Electric Co. is remarkable, not only for the massive simplicity of its water diversions, but the masterful way in which the engineers for the Company met incidental obstacles and rearranged power-houses, or water developments that in themselves constitute projects of first magnitude. Thus the special units of early plans became standardized equipment, and the unity of the whole was maintained on a broad basis. Power-house No. 5, as it is now taking form, is a beautiful example of these changes under the press of necessity.

Referring to the accompanying map, it is seen that the headwaters of the south fork of the Yuba river contain numerous small lakes. The outflow of a portion of these lakes concentrates at a point but little separated from the upper reaches of the Bear river. At this point every natural requirement for an enormous storage reservoir is found. A dam provides for the storage of 43,000 acre-feet of water, at a low cost per unit of storage. The artificial lake thus formed is known as Lake Spaulding. The upper lakes mentioned above, and diverted in part by the Fall Creek canal, provide an additional storage of 41,250 acre-feet.

At the dam site, the dividing ridge between the cañons of the South Yuba and the Bear is very low; in fact, by tapping the dam near its crest, the water could be carried across the ridge without tunneling. Instead, a tunnel 4456 ft. in length was driven, discharging the waters of the Spaulding project into the cañon of the Bear river. At the base of the dam, provision is made for utilizing this water in a power-house of 6000-kw. capacity. Thence the water is carried to the forebay of Drum power-house, where, under a head of 1375 ft., 50,000 kw. will ultimately be generated by four generators driven by Pelton-Doble tangential wheels. The tail water at present is discharged into the Bear river, although in the ultimate development it will be immediately picked up in a canal, and after passing through Power-houses No. 2 and 3, of 25,000 and 15,000-kw. capacity respectively, is returned to the Bear river 2.7 miles above the head dam of the Bear River canal. From this point the water is carried to the forebay of Power-house No. 4, where under a head of 342 ft. 12,500 kw. will be generated.

Headworks

The draft tubes of the turbines in Power-house No. 4 discharge beneath the level of a small reservoir or afterbay of 120 acre-feet capacity, which is really the

*Hayward, California.

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beginning of the development for Power-house No. 5. The normal elevation of the water surface in this reservoir is 1502 feet. Water is taken from this reservoir through sluice gates of ordinary type, and is carried through open ditch and concrete-lined tunnels a distance of 2 miles to Rock Creek reservoir, elevation 1460 ft., which serves as a resedimentation basin and regulating reservoir, and in addition provides storage capacity for the irrigation systems in case of interruption to the water supply from above. The initial capacity of this reservoir will be 500 acre-feet, but the construction of a 40-ft. dam, to be completed at a future date, will increase the capacity to 1232 acre-feet. From Rock Creek reservoir, the water is led in an open ditch, 3 miles in length, to the forebay of Power-house No. 5, elevation 1425 feet. The forebay is entirely artificial, the spoil from side-hill excavation being used to form the lower wall. It has sufficient capacity to accommodate peak-load variations.

Pipe and Tunnel

Leading from the forebay is 1106 ft. of 96-in. continuous wood stave pipe-line, made from selected Oregon fir. For controlling the entrance of the water, an 84-in. motor-operated butterfly valve is provided, this being one of a number of similar valves used throughout the development. The wood stave pipe-line follows the ground contour, with an occasional cut to keep below the hydraulic gradient. It terminates in a tunnel, lined with reinforced concrete, which pierces a low ridge. The overburden is shallow, the sole object being to keep sufficiently below the hydraulic gradient to insure a full pipe under most severe operating conditions. The tunnel is 463 ft. in length and at its lower end is joined to a steel pipe-line of the lengths, sizes, and construction tabulated below:

Length, ft.	Diameter, in.	Thickness, in.	Construction.
898	84	$\frac{5}{16}$	lap riveted
180	84	$\frac{3}{8}$	lap riveted
786	84	$\frac{3}{8}$	butt strap
878	84	$\frac{3}{8}$	lap riveted

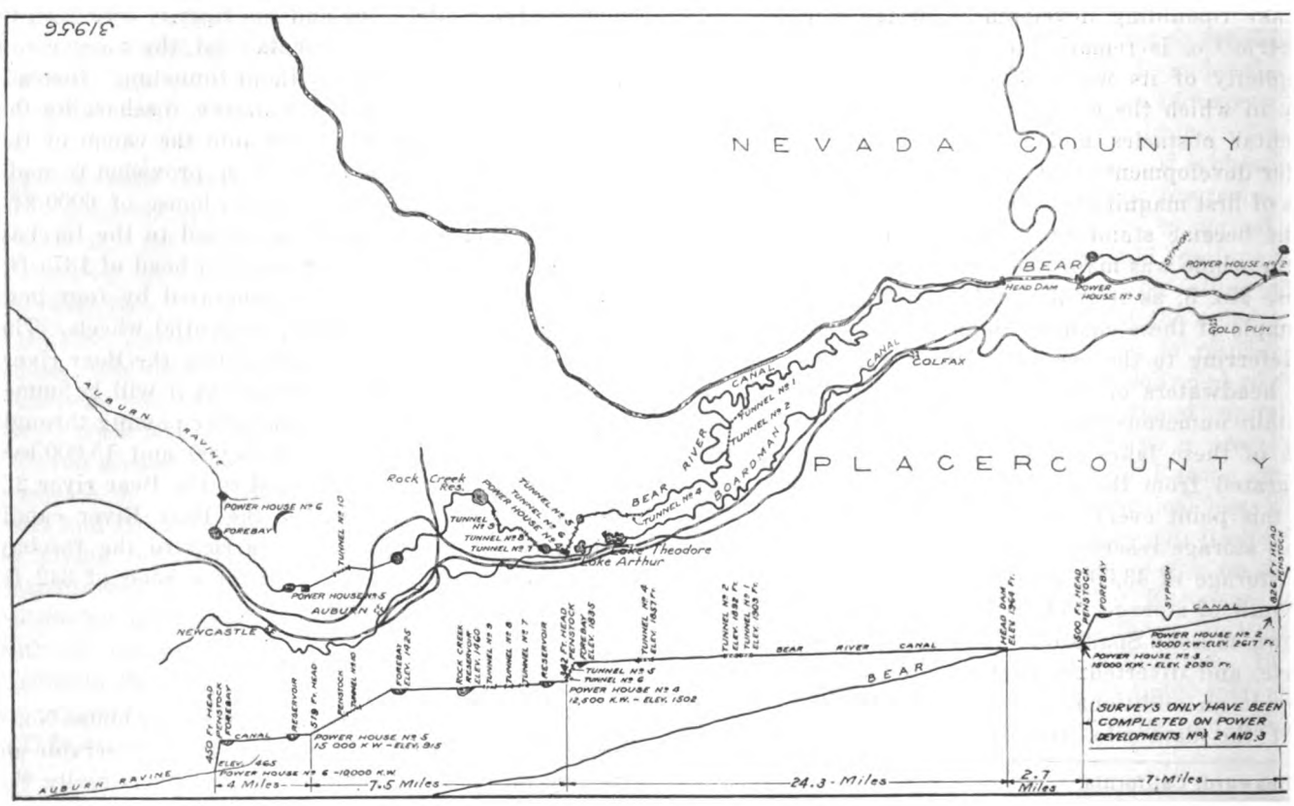
At this point, because of numerous small ridges, riveted pipe can be laid to follow the surface contour at much less cost than butt strap construction.

Length, ft.	Diameter, in.	Thickness, in.	Construction.
788	84	$\frac{7}{16}$	lap riveted
750	84	$\frac{3}{8}$	lap riveted
264	84	$\frac{3}{8}$	butt strap
822	84	$\frac{7}{16}$	butt strap
174	72	$\frac{7}{16}$	butt strap

This short section of 72-in. pipe is a portion of the pipe-line from Power-house No. 4, a slight change of plan leaving a surplus.

Length, ft.	Diameter, in.	Thickness, in.	Construction.
346	66	$\frac{3}{8}$	butt strap
246	66	$\frac{7}{16}$	butt strap
216	66	$\frac{1}{2}$	butt strap
119	66	$\frac{9}{16}$	butt strap
103	66	$\frac{5}{8}$	butt strap
142	66	$\frac{11}{16}$	butt strap

The last section enters the power-house and connects to the butterfly valve controlling the turbine. In laying this line, after a careful balancing of experience with various types of construction found among the pipe-lines of the Company, it was decided to use the cheapest construction possible. A trench was dug roughly following surface contour, of a depth to re-



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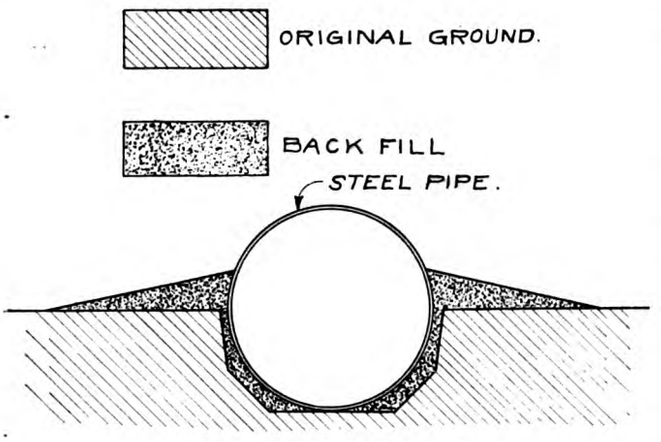


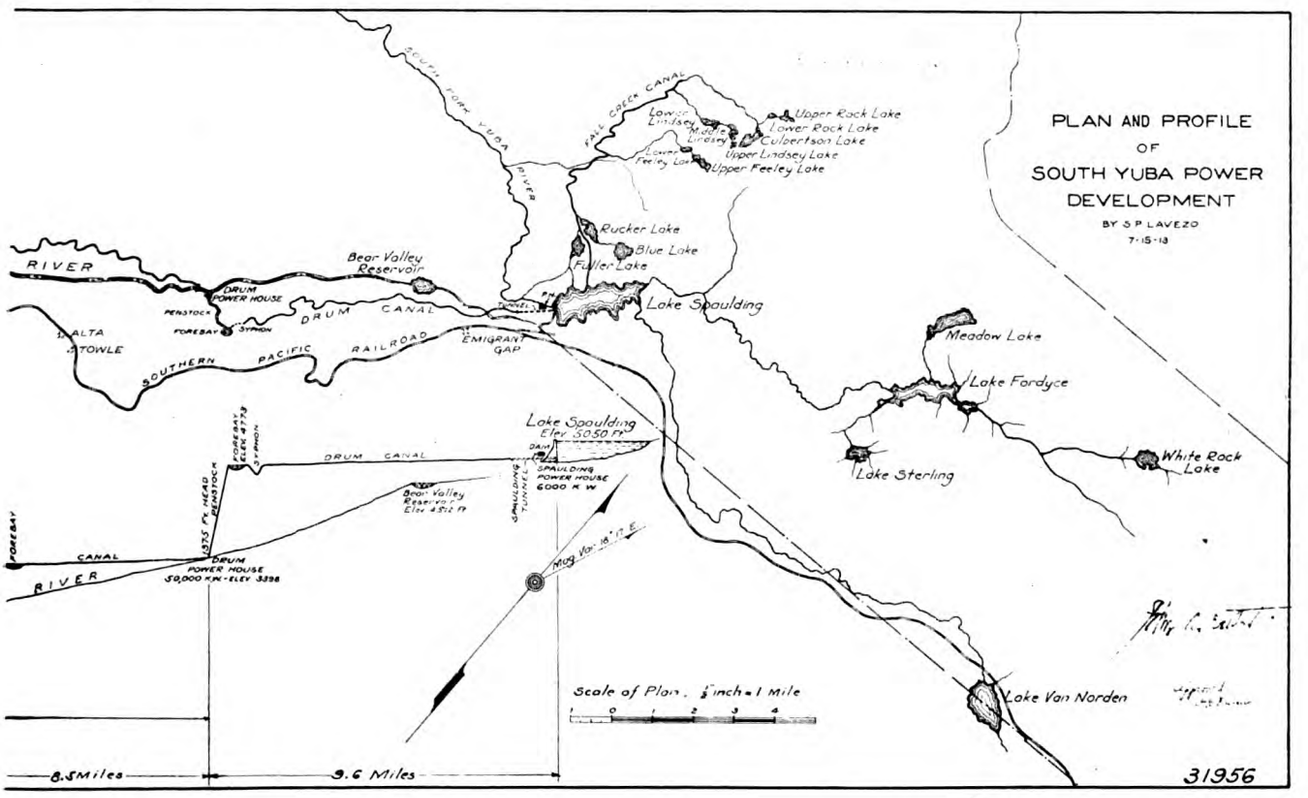
PIPE TRENCH AND BACK FILL.

ceive the lower half of the pipe. After riveting, the spoil was back-filled as shown in the accompanying sketch. In discussion with the engineers, it was developed that no pipe-line failure has ever occurred on the entire system that could even remotely be traced to corrosion; also that in so far as service is concerned, pipe entirely covered or for its entire length in part contact with the soil, gave better results than when supported on concrete piers. With pipes of such large diameter, the deformation from a true circle becomes important, reaching in some of the thinner sections as much as 4 in. Under pressure, the deformation is less, and the wall movement, when the pipe is emptied, is of sufficient magnitude to fracture the shoulders of the piers. For this reason pier construction was not used. All lines are thoroughly covered with a coating of asphaltum paint at the time of laying, and at irregular intervals this coating is renewed where the line is exposed to the weather.

Because of contour, a number of anchorages are necessary between tunnel and power-house. These are of concrete, and of shape and size as dictated by the location. Where the walls of the pipe are ½ in. or more in thickness, no slip joints are installed, but in the upper portion four slip joints, as described below, are provided. The policy of the Company engineers leaned toward slip joints and other pipe specials of structural materials only, as it was feared that sound steel castings could not be had in the thin, varied dimensional parts required in a suitable slip joint. The fabricator of the pipe and the slip joints installed did not care to undertake fabrication of joints to withstand the stresses imposed on the lower sections; thus the decision to eliminate all slip joints where the wall thickness of the pipe was ½ in. or greater.

The slip joints are of a standard type developed by the Company engineers; the construction is plainly shown in the accompanying sketch. Structural shapes and plates are used for every part except the cast-steel enclosing bands; a minimum of machine work is required, large packing space is provided, and the provision for linear movement of the pipe is far in excess of any probable requirements.

Because of the great length of line, it was necessary carefully to balance friction loss against cost of construction. The result was a pipe-line having a diameter and friction losses rather beyond the requirements of good practice. This had a material effect on the design of the turbine, as the following table of heads and capacity shows.



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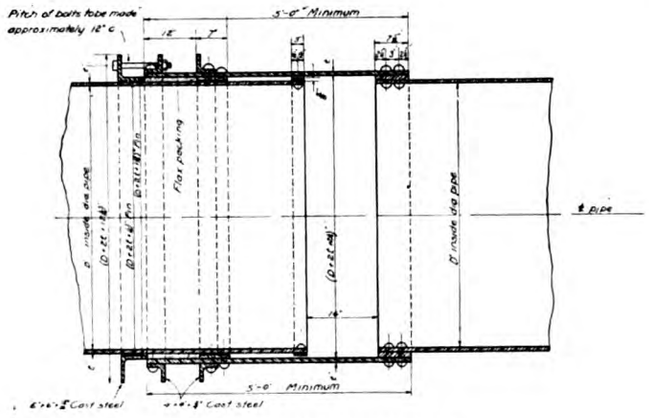


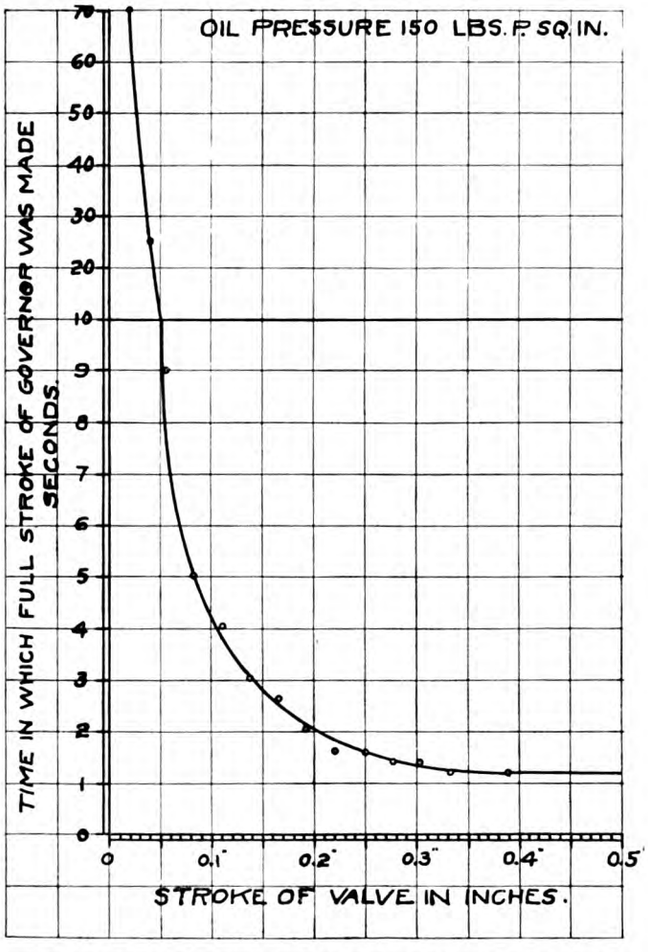
DETAIL OF EXPANSION JOINT.

The computations are based on a maximum draft of 465 second-feet.

Horse-power at turbine shaft.	Effective head, feet.
17,500	475
16,250	483
15,000	487
10,000	502
00,000	510

Power-house

Power-house No. 5 is situated in Auburn ravine, about one and a half miles south and west of Auburn.

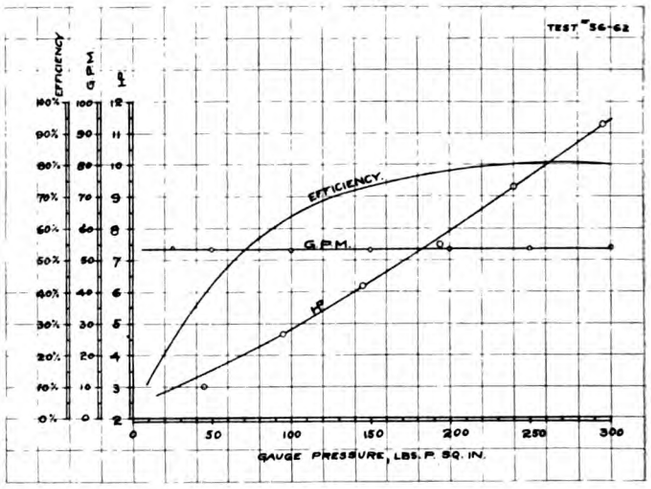


TEST OF SPEED-ADJUSTING DEVICE, PELTON-DOBLE DIRECT-MOTION GOVERNOR.

An excellent road, with a down grade from railway to power-house facilitates construction. Much attention was given to the architectural detail of the building, which is a one-story steel frame structure with reinforced concrete walls. It is carried on reinforced concrete piers, sunk to bedrock. Because of the heavy crane loads, a steel frame was considered advisable. The reinforced concrete walls, while thin, are self supporting, being merely steadied by the frame work. Heavy cornice effects are employed, the roof is of red tile, and the doors of oak. The outlet windows for the high tension lines are of double plate glass, 7 ft. square, 30 ft. 11 in. above the floor.

Over-all dimensions are: length 95 ft., width 41 ft. 8 in., height to roof deck 45 ft. The floor is of reinforced concrete, with a pit 7 ft. deep at one end to accommodate the transformers. No switch galleries are provided, the simple switchboard, high and low tension oil switches and all other equipment being on the same floor with exciter, generator, and turbine.

The steel draft tube is embedded in the concrete foundation of the generator. A separate tube is pro-



TEST OF TWO-STAGE PELTON-DOBLE GOVERNOR PUMP.

vided for the relief valve. A 50-ton crane, with a span of 40 ft. and equipped with electric hoist, but hand traverse, runs the entire length of the building. The intake and outlet pipes for the generator ventilating system described below, are carried beneath the floor, and under the roadway approaching the building.

Hydraulic Equipment

A change in general conditions made it advisable to complete Power-house No. 5 and retard the work on Drum power-house. Under these conditions it was decided to divert one of the Drum generators to Power-house No. 5. This action fixed the speed at 360 r.p.m. Under the head available, 510 ft., a single nozzle tangential wheel, having a specific speed of 5, would develop 1000 hp. To develop 20,000 hp., the predetermined size of unit would require 20 jets, a combination impractical under operating conditions. On the other

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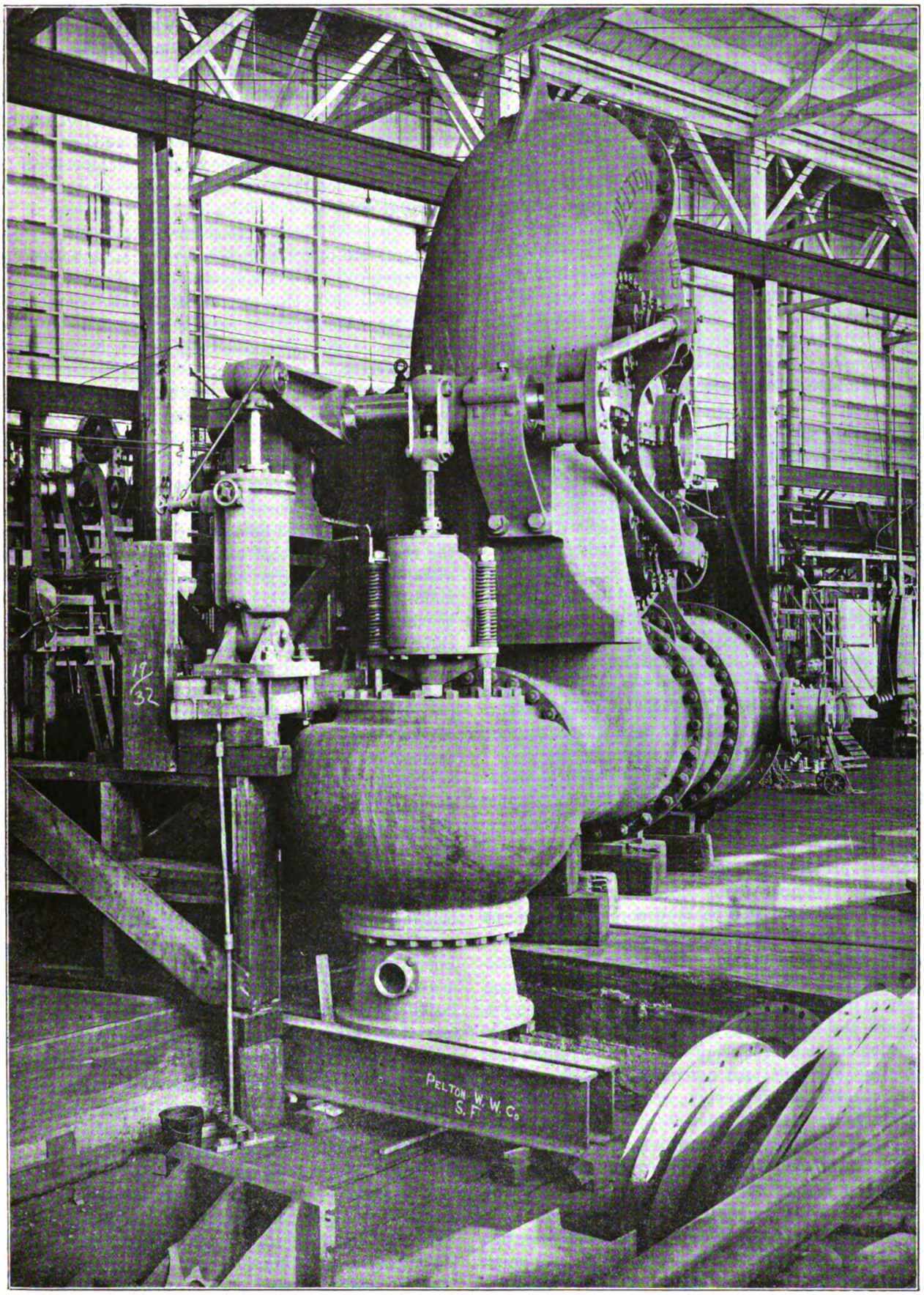

SHOP ASSEMBLY OF 20,000-KW. PELTON-FRANCIS TURBINE, SHOWING OPERATING MECHANISM FOR WICKET GATES.

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hand, a turbine with a specific speed of 20, would develop 18,000 hp. at 360 r.p.m. under a head of 500 ft. These limitations indicated a reaction turbine as the most suitable type of water wheel. The generator having been built for drive by a Pelton-Doble wheel, the shaft overhang was small. In the interests of economy, it was desirable to use the shaft of original design. To do this required a single discharge unit. Up to that time, no single discharge turbine of such large size had been built, but, after a mature consideration of the designs submitted by the engineers for the Pelton Water Wheel Co., the engineers for the Company decided to purchase a Pelton-Francis turbine, which is the largest single discharge turbine in the world.

The steel pipe-line is riveted to a 66-in. butterfly valve. The disc of this valve is designed to offer the least resistance possible to the flow of water. On the outer rim is a bronze adjustable wearing seat, machined at an angle to assure proper seating under all conditions. Special packing glands fitted with bronze stuffing boxes are provided for the trunnions; drainage of the valve body is accomplished by a bronze mounted drain valve; and a needle by-pass valve with renewable seat is attached to the body of the valve.

For normal operation of this valve, a 10-hp. reversible rotation induction motor designed to give an unusually high torque, is geared through an extended shaft, direct to the valve operating mechanism. A positive action mechanical stop prevents over-winding, while as an additional precaution, the motor pinion, by an ingenious spring-controlled disc clutch, is set to slip when the motor torque rises above a certain limit. This is adjustable within wide limitations.

An auxiliary hand control, separate from the motor control, is provided. This control is so arranged that 'over-reaching' is entirely obviated, the disc remaining in any position at which it may be set. A simple clutch mechanism provides for quick change from hand to motor, or reverse operation.

The case of the spiral type, is of annealed steel, cast in four parts to facilitate shipment. Each section is provided with eye bolts for handling. The construction of this case offered some interesting problems. Because of its large size, it was advisable to use portable tools for machining the various surfaces. The illustration on page 235 shows a portable radial drill and milling machine. An ingenious plan of applying full test pressure to the turbine casing was developed. After the flanges on the segments were machined, the entire case was bolted together. A special ring of cast steel was machined to fit the inner periphery of the casing, thus making a closed compartment of the spiral, to which any required pressure might be applied. The end covers are sectional, thus permitting quick access for inspection, and the complete removal of any or all wicket gates, without dismantling the entire unit. Four holes, spaced 90°, are provided in the turbine case for attachment of test gauges. The throat of the spiral is fitted with renewable wearing plates, properly tapered to maintain uniform water velocities. The draft tube is parted vertically and carries a bracket for supporting the thrust bearing.

The wicket gates are of crucible steel, with shafts rotating in bronze bushings on both sides of the case. The stems of the gates are hollow, and radial tubes convey the grease for lubrication from the central tube to the bushing bearing. End thrust of the gates is eliminated by special design.

The gate shifting ring is on the generator side of the unit, and operates gate levers through bronze links of predetermined breaking strength. These levers have eccentric adjustments providing for positive closure of all gates. The shifting ring is actuated by two steel rods spaced somewhat less than 180° and connected to a single cross-head on the rock-shaft.

The runner is of bronze, hand finished. The thrust is relieved by a reaction strut in the discharge elbow with an umbrella expansion which masks a portion of the vanes. The thrust bearing is relieved of 20,000 lb. pressure by this method of construction. The reaction strut is hollow, provision for draining entrapped water being made by cored holes. The thrust shaft rotates in the reaction strut, and passes through a bronze lined gland in the discharge elbow to a Kingsbury bearing mounted on a bracket. The housing of the thrust bearing is enlarged to form an oil reservoir having a capacity of approximately 25 gallons of oil.

A novel means of cooling the oil for this bearing is provided. Brass tubes are fitted into end plates, much like the tubes of a surface condenser; the total cooling surface being approximately 5 square feet. Cold water is constantly circulated through these tubes. The shaft of the entire unit is cooled by water, atomized under pressure, being drawn through the hollow interior. Water thus atomized has been found more satisfactory for abstracting the heat from these large bearings than a solid flow. The tachometer is mounted direct on the thrust-bearing housing. Escape of oil from the thrust-bearing housing is prevented by a frictionless device consisting of interlaced rotating and stationary discs. Longitudinal adjustment of the runner is provided by a special adjustment in the thrust bearing. Speed regulation is controlled by a Pelton-Doble governor designed as an integral portion of the entire unit. A fly-ball governor of extreme sensitiveness controls a pilot valve, which in turn controls a master valve admitting oil under 150 lb. pressure to either end of a trunnion-mounted pressure cylinder. The piston of this cylinder in turn is connected directly to an arm on the rock-shaft which actuates the wicket gates as described above. The angular motion of the piston is the same as the angular motion of the wicket gates.

The total pull of this piston is 40,000 lb. It is designed so that the time element of the stroke can be varied during operation, this element being capable of variation from a complete stroke of the piston, corresponding to a complete opening or closing of the

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wicket gates, in 1.2 seconds to one complete stroke in 6 minutes. The curve herewith shows the relations up to 70 seconds. Because of the long pipe-line, and consequent great moment of inertia of the water column, quick opening of the gates under load increase is essential to good regulation. Oil under 150 lb. air pressure is supplied by a Pelton-Doble two-stage rotating pump, sufficient storage for four complete strokes of the piston being provided. A separate sump tank is provided. The entire oil system is of the open type, which is considered an improvement over the pressure vacuum system commonly employed, as the chemical and mechanical breaking down of the oil which occurs under long continued high pressure is prevented. Speed variations for synchronizing is obtained through a small motor variator, controlled from the switch-board.

The oil pump of itself is of much interest. The efficiency curves herewith shown exhibit results much better than for pumps commonly operating with such small quantities of oil under such extreme pressures.

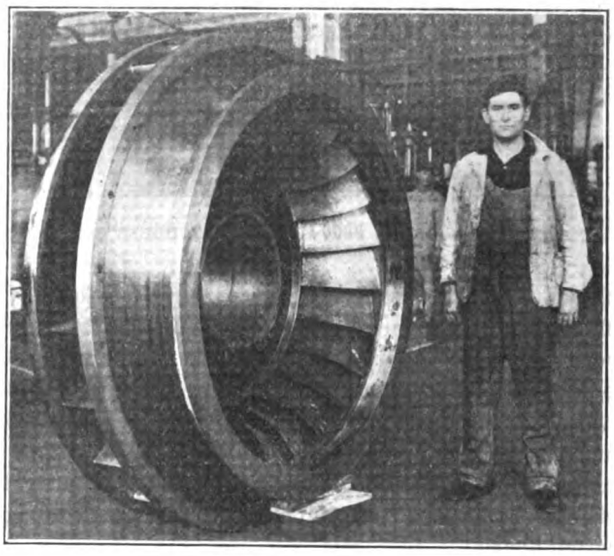
Because of the impact of the water column in a pipeline of the length found in this development, special care was taken to avoid destructive surges. In the unit under consideration, this is accomplished by means of a Pelton-Doble cascade type water economizing relief valve. This valve is actuated by the main rock-shaft, directly driven by the governor. With a sudden load rejection, the relief valve is opened, and then is gradually closed, an adjustable time limit device maintaining the rate of closure at a point slow enough to prevent a dangerous rise of pressure. On minor load rejections of a magnitude insufficient to set up dangerous surge pressures, the relief valve does not open. Positive seating is assured by two coil-springs under compression when the valve is open. The discharge capacity is increased by a reaction cone.

Electrical Equipment

The generator supplied by the Westinghouse Electric & Mfg. Co., was originally intended for use at Drum power-house. In drawing the purchase specifications of these generators one feature was emphasized, namely, utmost reliability of service. The temperature rise was limited by a stringent series of clauses. In effect these clauses provided that at no point of the generator should the temperature rise be more than 40°C. above room. Any method might be employed by the Company engineers to determine this rise, and in the tests actually conducted, thermometers, sixteen exploring coils, and the 'rise of resistance' methods were employed. Some idea of the stringency of this specification may be obtained when comparison is made with other large generators having 'hot spots' showing a rise of 40°C. more than the average rise of temperature as determined by the 'rise of resistance' method. The data for the design of generators of this size under such rigid specification limitations, were rather scanty, so that ample factors of safety were allowed. The copper of the armature is heavy, more than 800 c.m. per ampere being provided. Particular attention to ventilation was also given.

The entire machine is enclosed in a cast iron housing and the air for ventilation is drawn from the outside, clean cool air being distributed to all portions. Two fans are provided, one mounted at either end of the revolving field; these blow the cool air through the ventilating ducts, which are wider and more numerous than customarily provided. The armature is wound to 6600 volts, the customary two coils per slot arrangement being employed. These coils are insulated with mica, guaranteed to withstand 115°C. continuously.

The core of the field is built up of 2-in. steel plates machined to surface. Two rows of ventilating ducts are provided on the periphery, these in turn communicating with lateral ducts leading to either side of the field. The centre discs, between the above men-



ROTOR FOR TURBINE.

tioned ducts terminating at the periphery are not perforated, in order to provide better ventilation.

The pole pieces are held in place in dove-tailed slots, one dove-tail per pole, by taper steel wedges. Solid disc construction was used, not for strength, but to increase WR^2 effect. This, in the generator alone is 1,750,000 lb., or at normal speed, a kinetic energy of 38,000,000 ft. lb. As the Pelton-Doble wheel which was originally intended to drive this generator has a runaway speed nearly twice its normal speed, the discs of the rotating field must necessarily be securely attached to the shaft. It was decided to make a press fit of extra strength, and a press allowance of 0.020 in. was specified, the shaft diameter being 26 inches.

In view of the care taken in drawing the purchase specifications, the factory test is interesting. The machine was short circuited thirty-six times, and no mechanical weaknesses were revealed. The approximate short-circuit current was eight times normal current, dropping in a few cycles to approximately twice nor-

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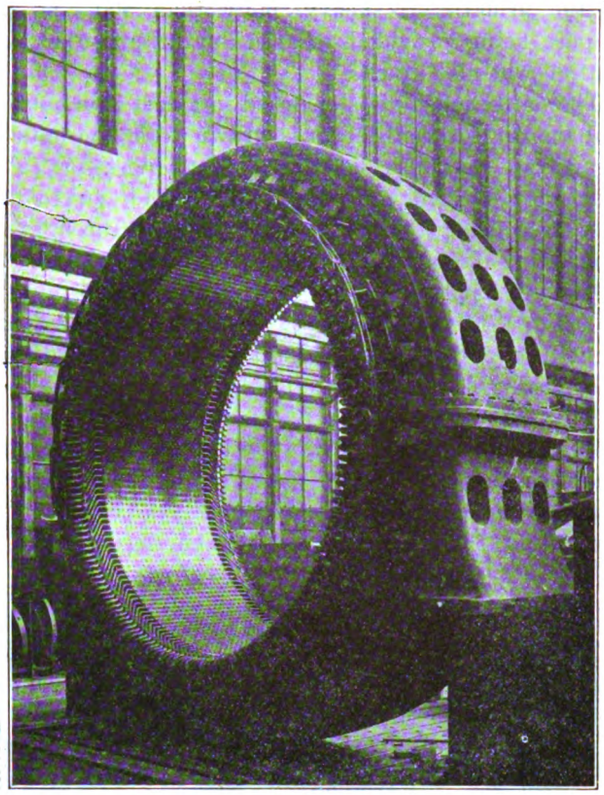


ARMATURE, 12,500-KVA., 6600-VOLT WESTINGHOUSE GENERATOR.

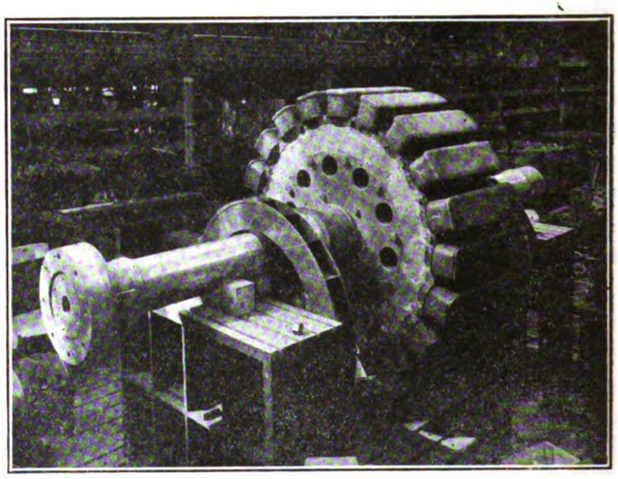
mal current, the internal reactance, rather than WR^2 effect, being the limiting factor. Temperature results were very satisfactory. No spot was found where the temperature rise exceeded by more than 2½°C. the average rise as determined by 'rise of resistance' method. As this generator will be installed, eight of the sixteen exploring coils with which it is provided will be connected to temperature indicators on the switch-board.

The exciter, a single unit, is a 100-kw. 125 volt Crocker-Wheeler generator driven direct by a 125-hp. Pelton-Doble tangential wheel, and operating at a speed of 514 r.p.m. A needle regulating nozzle, operated by a ½-hp. motor, and controlled from the switchboard, is the only governing device on the water wheel. Provision is made for direct connection to an induction motor supplemental to the tangential wheel, should such course prove desirable at a future date.

The switching arrangements are of the simplest type possible; a 15,000-volt, motor-operated, hand-controlled switch connecting the generator to a bank of three single-phase transformers. On the high-tension side two 125,000-volt, solenoid-operated, hand-controlled oil switches of the standard type developed by the Company permit the selection of either of the two high-tension lines comprising the Drum-Cordelia line. Standard single-phase, 4250-kva., 6600/125,000-volt, water-cooled transformers, connected in star, are used. Two taps are provided on the low-tension side, permitting a high-tension range of 110,000, 115,000, 120,000, or 125,000 volts.

Construction work on the above described plant is progressing slowly, and it is expected it will be completed during 1915. F. G. Baum, chief engineer for the Pacific Gas & Electric Co., has general charge of all work. J. P. Jollyman, engineer of electric construction, and H. C. Vensano, civil engineer, are directly in charge of design and construction, and to them the writer is indebted for the data given above.

The Pelton Water Wheel Co. supplied all the hydraulic equipment, the Westinghouse Electric & Manufacturing Co. the electrical equipment, with exception of the exciter and a portion of the switch-board, and Schaw Batcher company fabricated the steel work for the pipe-line.



ROTOR, 12,500-KVA., 6600-VOLT WESTINGHOUSE GENERATOR.

When Professor Luigi Luiggi, the eminent Italian engineer, looked around Lybia, on the Mediterranean, for suitable stone to build a breakwater for a harbor, he was confronted with a difficulty. There was plenty of calcareous sandstone available, but, of course, it was unsuitable, so he looked among the ruins of structures built in Roman times in the hope that ample and substantial blocks would be found, as in many places there were, to use his own words, magnificent specimens of marble, which had been used by the Romans in the adornment of some now historical buildings. He happened upon a huge wall of dressed stone, partly covered with earth, he last month told a Melbourne audience, mainly composed of engineers, and, throwing a view of the wall on the lantern screen, enjoined the spectators to look closely into the picture. The wall showed slight signs of having been weathered, but the professor added, with a twinkle in his eye, "history has informed me that it had stood the test of time, that it had borne the brunt of battle of weather for many centuries—aye, some 2000 years, so I took the 'big risk' of using the blocks, and should they crumble in another century, well, I will not be in Lybia to hear what might be said against their use." Those present fully endorsed the view that the 'risk' was a reasonable one.

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Rights-of-Way, a Problem in Highway Development*

By AUSTIN B. FLETCHER†

Adequate rights-of-way of 'locations' are of prime importance in any highway system, and too little attention has been given to this feature of highway work.

In the mad haste to get the roads built so that the automobile enthusiasts may use them 'while they are yet alive,' we are prone to forget that the highway location is the one really permanent feature of the road work.

The time to secure proper locations for the roads, and widths sufficient to serve all purposes for long years to come, is now. If we wait until some future day to correct improper locations, and to secure suitable widths of right-of-way when we have more leisure, we will have wasted much money in pavements constructed and the land needed will cost much more and will be more difficult to acquire.

It goes without saying that all land-owners are more complacent in giving up portions of their property to the public before the improvements are begun than at any time afterward.

In some of the older states the people came long before 'sectionalization' by the government was thought of, but in the Middle West and on the Pacific Coast most of the land was divided years ago, checkerboard fashion, by the government surveyors.

Rectilinear Method of Road Location

The highways in the older states were laid out, or in most cases, simply grew where the travel wanted to go, but in the flat prairie land of the West, and even in the Pacific Coast valleys, the roads were often, if not generally, laid out straddling the section lines, the centre of the right-of-way being usually coincident with the section line. This plan had the merit of lessening the area of land deducted for road purposes from the holding of an owner by making his adjoining neighbor provide one-half of the land required for the roadway.

This method of road location often proves to be an embarrassment to the present-day road builder, since this time-honored rectilinear scheme does not fit the present needs. Centres of population seldom have occurred in conformity to such a plan; often the railroads have determined the location of the towns. In such cases it is desirable, considering the volume of 'through travel' in motor cars and trucks, to construct the roads in the most direct lines possible. This often entails rights-of-way running diagonally across the sections, cuts up land holdings, and makes trouble generally for the right-of-way department.

But when the rectilinear plan has been carried still further and the land-owners, to conserve particularly good areas for agricultural purposes, have had in times past enough influence to cause the county authorities to discontinue or vacate portions of ways along the section lines and have introduced right-angled turns into the half or even quarter-section lines, then the engineer has a task worthy of his mettle to secure a proper location for his improved road. And if the road be in an orange grove section, his joy is indeed complete.

The writer knows of a main paved road in one of the California counties which has at least ten right-angled turns in it in a distance of about 20 miles, and this road passes through no town or city, and is practically level. In planning their new highway system, several years ago, that county gave up as hopeless the task of securing a direct route in the locality referred to; so for many years to come, all through travel over that 20 miles of beautifully paved highway must be subjected to the dangerous right-angled turns and to the unnecessarily increased length.

There is reason in cities and other centres of population for ways laid out in rectilinear fashion. In the open country, there is no excuse for planning a new highway system along such lines. Land should be condemned if the owners will not donate it.

There should be as direct a line between important centres as the topographical conditions will permit.

Width of Right-of-Way

Assuming that the best alignment for the highway has been adopted taking into consideration the factors of topography, climate, and traffic needs, present and prospective, the next question confronting the highway engineer is the width of the right-of-way.

It is certainly desirable that in any highway system the right-of-way be of uniform width, but as a practical matter each link in the system must be considered by itself. Near the centres of population, it is obvious that the pavement and the rights-of-way must be wider than in remote rural communities, sparsely settled.

It is the writer's opinion, however, that for a minimum width of right-of-way 50 ft. is none too much, and that wherever possible a width of 60 ft. is the least that should be secured, even in sparsely settled localities.

Difficulties in Obtaining Rights-of-Way

It is inevitable that street railway, electric light and power, gas, telephone, and telegraph companies will at some time clamor for locations in the highway, and although too little attention has thus far been paid to

*Read before American Road Congress, Atlanta, Georgia, November 1914.

†State Highway Engineer of California.

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the matter, tree planting and other landscape treatment of our country highways will have to be provided for.

In many of the older sections of the country, right-of-way problems are not serious affairs. Ways have been established there, well defined and traveled, for many years, and right-of-way improvements consist chiefly in rectifying the side lines of locations where abutting land-owners have encroached successfully under the 'open adverse possession' statutes which apply in some of the states.

But in many localities, the acquisition of necessary easements of way becomes as important a factor in the plan and progress of highway work as the road itself.

In the more sparsely settled communitions, roads have been built following lines of least resistance, in the valleys the 'sectionalized' land lines, and in the hills wherever the ranchers could best spare it. Accordingly, when modern road building methods are invoked, it becomes necessary to alter meandering and precipitous roads by straightening, widening, and improving the gradients. The needed rights-of-way for these purposes must be acquired.

This feature of the work is particularly annoying to the highway engineer. His desire is to press forward the best line in the best way in the best time. When he is confronted by a hostile, reluctant, or indifferent land-owner, the engineer usually loses his patience.

It is not alone in cases of new rights-of-way that there is litigation, but frequently old surveys do not exactly coincide with existing ways, many of which in course of usage have become winding and irregular, and consequently additional land has to be acquired to widen, straighten, or alter them.

Owners often build fences or cultivate up to the used portion of the ways and resist the shifting of the lines and delay the progress of the work. In many cases much time is lost where owners who have allowed people to pass and re-pass in vehicles without objection for years, assert adverse claims and work must be delayed to avoid complications.

One has also the experience of attempting to use dedicated rights-of-way shown on plats recorded in times past, but which have been entirely unused or allowed to fall into disuse, and then being confronted by claimants, with their attorneys, who contest the rights of the public therein.

There are many unavoidable delays in obtaining rights-of-way, arising outside of the disputed rights-of-way mentioned. Even when the owners intend to be liberal, they exact a great deal of information before signing the deeds of easement. The records have to be searched to ascertain the true owners of the lands affected; owners must be notified or corresponded with; draftsmen are asked to furnish sketches to many owners defining the rights-of-way desired; visits to the lands must be made and surveys inspected; minor adjustments of lines and fences must be settled upon; vacation proceedings arranged and prepared, abandoning the old roads or portions of roads over property so as to leave no incumbrance on the same when the new road is located and built; co-owners must consult among themselves before executing deeds of easement; ownerships involved in probate proceedings or title litigation must be searched and a good title to the roads acquired out of the confusion; and there are other details *ad infinitum*.

Organization Required

These many difficulties have led, in the writer's Western experience in highway work, to the employment of the subtle 'right-of-way man,' who needs to be a psychologist as well as a philosopher. His chief duty consists in attempting to wheedle the oftentimes contrary land-owners into signing the needed conveyances and to convince them, usually, that their duty to the public lies in giving their property gratis. Such an employee becomes a very important member of the organization. His troubles are many.

In addition to the 'right-of-way man' and his assistants in the California work, the help and advice of an attorney learned in eminent domain practice has been had who devotes all of his time to the highway work and whose principal activities are in right-of-way matters. The writer takes this opportunity of acknowledging the assistance of Charles C. Carleton, attorney for the California Highway Commission, in the preparation of this paper.

Legal Procedure

In many jurisdictions, if the deeds cannot be acquired by diplomatic methods, war must be declared in the courts, and the highway board must desist from its efforts to promptly furnish the community with necessary thoroughfares until the courts finally determine that the litigious land-owners' holdings may be entered upon.

There is a great lack of uniformity in the different states in the methods of paying or securing the payment of damages in taking property for public highway purposes. Such methods are, of course, regulated entirely by the constitutions and statutes of the respective commonwealths.

In some states it is not necessary for the authorities to pay for private property taken for public use in advance of the actual taking of possession. The property owner has been provided with a method of making his claim and with a tribunal constituted so that he may enforce his claim and obtain his damages therein.

In such jurisdictions, highway work may speedily progress and laying out of routes may be followed by immediate construction. The property owner, if he is dissatisfied with the original offer of payment or the award made to him by the public authorities, may pursue his remedy in the appropriate court even though his land has already been occupied by the public.

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The public has the advantage of celerity in the progress of its enterprise; the land-owner is protected by ultimate and adequate compensation for his injuries, and in one state, at least, he may wait until after the state highway is completed before he must file his petition for jury trial, it then being evident to all interested parties just what damage has been done, not only by reason of the land taken, but by the road construction as well.

But some states are so unfortunate as to be harassed in their public work by constitutions and statutes expressly requiring prepayment before entry upon the land required for public use.

Comparison of Legal Methods

The writer has had to do with highway activities in two states which have operated under each of these methods, the one having the right to take land necessary for public use in advance of satisfying the owner; the other requiring that if the owner is not pleased with the offer made to him by the public authorities, he may stand back on his property with a shotgun and compel public officers to initiate proceedings in the court and remain off his property until after judgment has been obtained and the assessed damages paid into court for his use and benefit.

In the first mentioned commonwealth, the welfare and progress of the people as a whole are superior to the notions and eccentricities of an individual land-owner.

In the other state, the recalcitrant land-owner may oppose and delay the vital needs of a city, county, or state, as the case may be, and his immediate rights predominate over the requirements of the community at large.

No rights-of-way, in states having regulations similar to the latter, can arbitrarily be taken by the people before the same, after a vast amount of red tape, have been acquired by donation, purchase, or condemnation; that is, a taking cannot be made and compensation and damages adjusted afterward.

Consequently obstinate land-owners are able to 'hold up' the community at large until it either pays the demands or contests the question of compensation and damages in trials, the latter usually requiring considerable time, particularly in the case of the belligerent or indifferent land-owners residing in other states or foreign countries when long publications of summons are necessary before the suits may be commenced. The Western states appear to be particularly oppressed by such roundabout methods of entering upon private property and installing improvements for the benefit and welfare of millions of people.

For illustration, under such a system a large Western land-owner owning an area equal in size to an entire Eastern state may be luxuriously traveling abroad. A county has voted and issued bonds for a large amount to construct important highways. Before the great ranch can be entered upon, except for surveys, a correspondence must ensue between the public authorities and the land magnate. The owner declines to sign a conveyance, and the people are compelled to commence proceedings in eminent domain against the absent owner. Before a trial can be had, summons must be published for sixty days, and then follow the tedious court proceedings.

It usually happens that pugnacious land-owners demand some exorbitant sum. The court may upon trial only allow a small percentage of their original claim, but during the pendency of the action an important artery of travel may be debarred.

Such a system is absolutely hostile to progress; the people should be greater than the individual.

The writer submits that at this time, when modern highway construction is becoming so active throughout the nation, it is apparent that there should be simplification in the constitutions and statutes relating to the subject of eminent domain, and that this Congress may render invaluable service in assisting to bring about so desirable a result.

Title Technicalities

Too much attention can be given to the title technicalities of right-of-way activities. It has been an almost universal practice for public boards performing road work to obtain at great expense exhaustive abstracts of title to ascertain land ownerships.

The writer has had under his supervision the acquisition of hundreds of miles of highway right-of-way in California, where the securing of rights-of-way could not be made much more difficult, complex, or annoying, yet the purchase of expensive abstracts of title has been dispensed with. Out of hundreds of ownerships affected, not one serious complication has resulted from the following plan:

When the field parties are making the original surveys, the chiefs of party usually inquire from the occupants of the land surveyed who the owners or those interested in the property may be. This gives a clue to the ownership. Thereafter, one of the staff visits the proper county offices and ascertains from the assessment rolls or the records who purport to be the owners. Deeds or agreements are then prepared, containing the proper descriptions, and it is very rare, indeed, that any objection has been made to the accuracy of the instrument submitted.

By thus performing its own title searches, even though they may not have always been the most exact from a title lawyer's standpoint, the authorities have saved thousands of dollars and have never had an injunction or ejectment proceeding instituted against them by objecting land-owners.

By taking a few remote chances of complaints, work which would otherwise be hopelessly harassed and delayed in the performance of a highway project, may proceed.

Furthermore, in most states, title may be obtained to ways by user or implied dedication by the passage

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of time. It has been the custom in California where the present traveled roads are wide enough for use and properly located, to place the monuments and build the pavements and assert jurisdiction thereover, the theory being that if the owner objects, the authority's title being fundamentally weak, the state can 'condemn' as rapidly as the alleged owner can 'oust.'

Classes of State Roads

The so-called state highways in the several states may be divided into at least two classes with regard to the control by the state of the roads after they are built—namely, those which are maintained by the state and over which the state assumes complete charge from property line to property line with the possible exception of the policing of the way, and those sometimes called state-aid roads where the commonwealth has little or nothing to do with the maintenance of the roads and the burden is placed by law upon some subdivision of the state, usually the county.

The writer has had to do only with the class of state highways first mentioned, and he believes that the state ought to have as complete control as possible over its highways, state or otherwise. Such control, however, places a considerable burden upon the authority which administers the law.

More is expected of a state organization, and rightly so, than of a county board. Its work must be done carefully and accurately. The surveys and plans of the state highways must be well made, and no small part of the engineering costs is chargeable to the careful work needed in running out and establishing the right-of-way lines.

In trying to establish old right-of-way lines in anticipation of highway improvements, much difficulty is often experienced in finding any landmarks to indicate what the right-of-way really is, and the old surveys and plans often prove to be of little assistance. Often the roads to be taken over and built as state highways were laid out when the land was of little value and the surveys were carelessly made or the descriptions carelessly recorded. With the lapse of time buildings, trees, and other similar features, which formerly marked the location of the road, have entirely disappeared, and the traveled ways have shifted from place to place as the action of the elements or the whims of the travelers have directed. Fences, if they exist, have been so moved about that they in no way indicate the original line of the road.

In all state work with which the writer has had to do, it has been the policy to fix the right-of-way lines on the ground by setting proper monuments in the soil to such a depth that they serve as markers for all time to come.

In planning a new system of highways, careful plans should be made and permanent monuments set. Future generations will surely appreciate such records, and the additional cost of this kind of work should not forbid.

UNIT BIDS, SAN FRANCISCO TWIN PEAKS TUNNEL PROJECT

By reason of technical irregularities, the bid of Hans Pedersen, of Seattle, submitted on the second call for bids for constructing the Twin Peaks tunnel, was rejected, and a third call for bids issued to be opened on October 30. As a result, five bids were submitted, one of which was rejected by reason of irregularities. The contract has been awarded to R. C. Storrie & Co., of San Francisco, and the unit bids submitted were as follows:

Estimate of City Engineer, $3,433,535.

Bidders:

No. 1—Void.
No. 2—Hans Pedersen, 23 Madison Blk., Seattle.
No. 3—R. C. Storrie & Co., San Francisco.
No. 4—Twohy Bros. Co. and P. Welch, Portland.
No. 5—McArthur Bros. Co., Chronicle Bdg., San Francisco.

	No. 2.	No. 3.	No. 4.	No. 5.
Total amt. of bid..	$3,450,300	$3,372,000	$3,669,630	$3,385,960
2940 ft. standard tunnel section for earth or soft material, per lin. ft.	330	300	360	304
4020 ft. standard tunnel section for soft rock, per lin. ft....	265	250	266	245
2500 ft. standard tunnel section for hard rock, per lin. ft....	190	175	222	202
30 ft. of 29-ft. 6-in. tunnel section of reinforced concrete, per lin. ft.....	350	350	429	322
1360 ft. standard flat top section of reinforced concrete, per lin. ft.....	260	400	233	320
1 taper connection at Clover St. for sum of	62,850	50,000	68,500	61,300
1 easterly approach..	21,000	50,000	26,000	24,000
1 retaining wall.....	37,450	10,000	36,000	20,000
1 Eureka Valley station	132,000	120,000	156,000	132,760
1 ventilating intake, 18th St.	7,200	8,000	7,000	4,000
1 ventilating intake, Relief Home	20,000	15,000	22,000	30,000
1 Laguna Honda station	280,000	225,000	326,400	262,000
1 westerly portal....	7,500	10,000	8,460	16,800
1 drain, 18th St....	4,800	2,500	4,700	3,800
1 drain, Collingwood St.	2,900	2,500	2,100	2,780

Some contractors seem to think that they can get out of trouble at the eleventh hour by the use of a water-proofing application, or that they can do poor construction work provided they have some water-proofing compound in their mixture. Neither water-proofing ingredients nor water-proofing applications after construction are going to help materially a bad design or careless construction.

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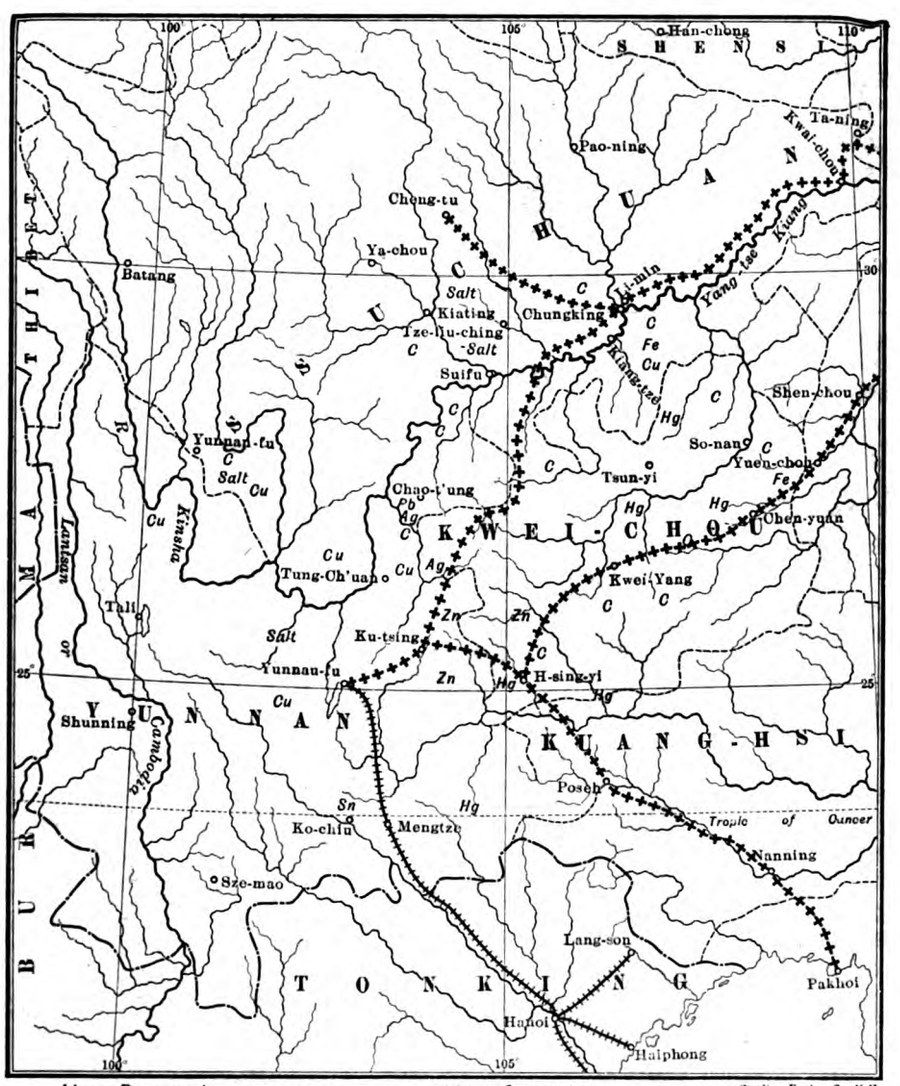
Petroleum, Gas, and Brine Wells of Ssu-chuan, China

By THOMAS T. and M. CARLETON READ

The agreement made last year between the Republic of China and the Standard Oil Co. of America for the exploration and development of the petroleum resources of the provinces of Chih-li, Shansi, Shensi, Kansu, and Ssu-chuan has led to an awakening of interest in deposits which are comparatively little known. One of us has elsewhere summarized[1] the data available as to petroleum in China, which is naturally somewhat vague, as it was not until recently that petroleum has been an object of search. The best known district is in Ssu-chuan, where in drilling wells for brine, gas and petroleum are also found in less amounts, and the gas is utilized for evaporating the brine. The most famous district is that west of Tze-liu-ching, in east-central Ssu-chuan, about 100 miles west of Chungking, the chief port on the Yangtze, and an equal distance south of Cheng-tu, the capital of the province. From Tze-liu-ching, which takes its name from an old brine spring, the salt belt stretches about 20 miles southwest and has an approximate width of 10 miles. Salt is found in a great many other places in Ssu-chuan, as shown on the accompanying map, but a description of this single district will suffice. It has been briefly discussed by Alexander Hosie,[2] who visited it in 1882, and also by E. H. Parker, who has described it in the *Journal* of the Royal Asiatic Society. The most detailed description is that of Louis Coldre, who during his many years of service as *missionaire apostolique* in that part of Ssu-chuan had ample opportunity to secure accurate information which he has embodied in an important paper.[3] What follows is based on a translation of this paper which one of us has made. The illustrations are taken from M. Coldre's paper, and the notations as to the distribution of minerals, on the map, are those of Alexander Hosie, with some additions of our own.

[1] 'Mineral Resources of China,' *Trans.* Amer. Inst. Min. Eng., Vol. 43, p. 1.



MAP OF SOUTHWESTERN CHINA.

Ssu-chuan is the largest of the 18 provinces of China, having an area of over 200,000 square miles or almost exactly that of France. Its population is about 70,000,000 people, or almost double that of France. The western half of Ssu-chuan borders on Thibet and is so elevated and mountainous that it is highly inaccessible and supports but a scanty population. Compared with this rugged region the eastern half is more in the nature of a Piedmont plateau or, more strictly, an elevated basin, of a roughly triangular shape, with mountains on the three sides. The surface of the basin consists generally of Tertiary sediments, chiefly thick deposits of red clayey sandstones and sandy clays, from which Von Richthofen named the region the Red Basin. The geology is much more complicated than this brief statement would indicate, for much of mountain-making movement is post-Tertiary, but for present purposes this will suffice. The region is far distant from the

[2] 'Three Years in Western China,' by Alexander Hosie, London, 1897.

[3] 'Les Salines et les Puits des Feu du Se-Tchouan,' L. Coldre, *Ann. de Mines*, Vol. 19, p. 441, 1891.

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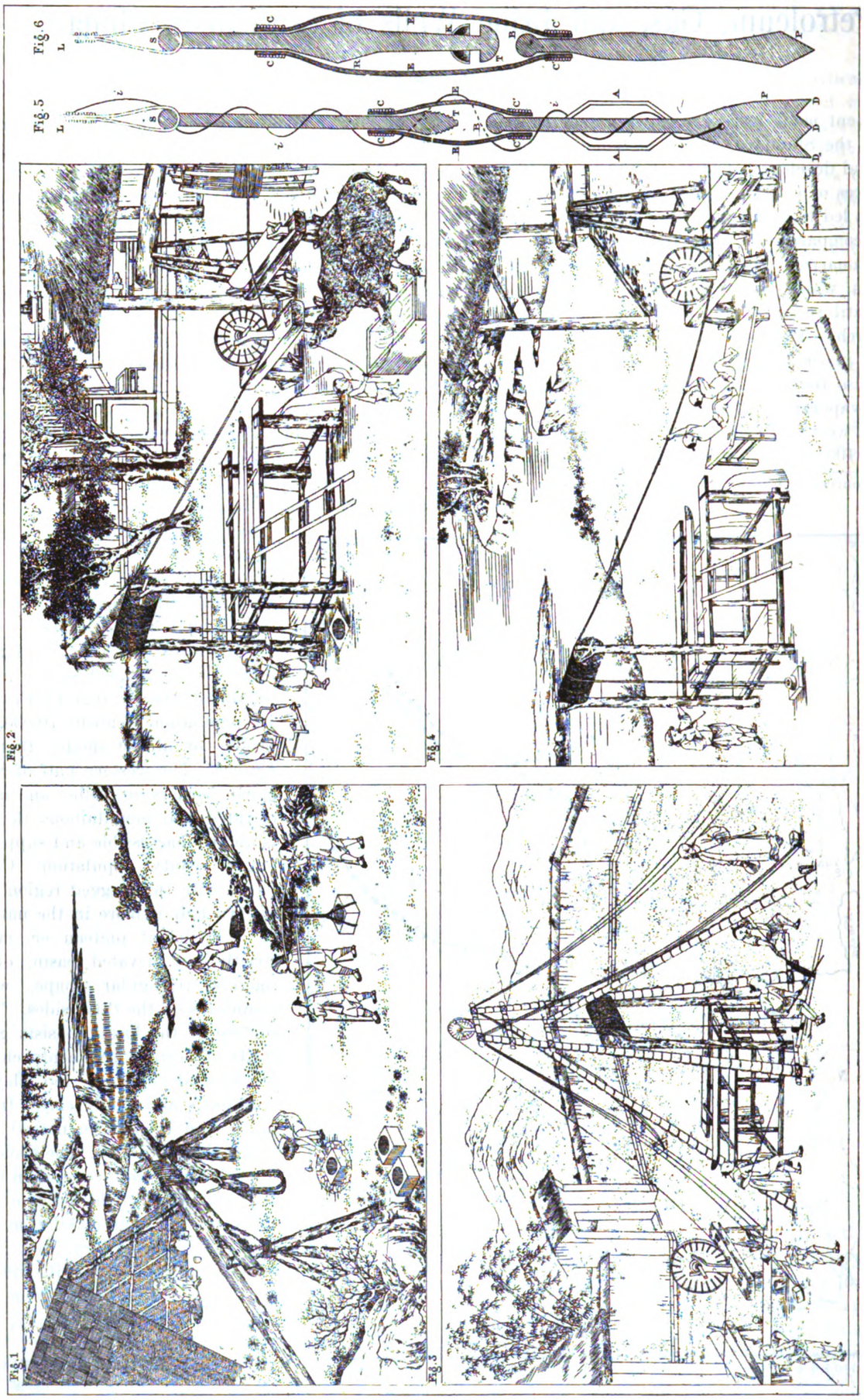

FIG. 1. LINING THE WELL TO THE SURFACE. FIG. 2. STARTING DRILLING. FIG. 3. PLACING BAMBOO CASING IN PLACE. FIG. 4. FILLING THE SAND PUMP.
FIG. 5. STRING OF TOOLS FOR SHALLOW DRILLING. FIG. 6. STRING OF TOOLS FOR DEEP DRILLING.

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seacoast, and being difficult of access because of the mountain barriers already mentioned, salt, that universal necessity of human diet, can only be obtained from the seacoast at high cost. The tribes living between this area and the seacoast have at many periods in history been at war with the Ssu-chuanese, and as the region is a rich and fertile one, supplying almost every other human necessity, the people naturally proceeded to develop a local salt supply; which they did at an early period, probably earlier than the third century, A.D. Salt springs, appearing at the surface, doubtless gave the suggestion of boring down to increase their flow, and as a very profitable trade in salt with adjoining regions was built up, an elaborate technology was developed which is somewhat astonishing to anyone who is inclined to believe that nearly all really useful technology has been developed by Anglo-Saxons in the past few centuries.

In most places the brines are found in Triassic sediments, but in the Tze-liu-ching district the strata seem to be much faulted; at any rate the brines are found beneath the Carboniferous strata and even deeper in the series. The petroleum occurs high in the series, while gas in strong flow is found well below the top of the Carboniferous, just before reaching a thin seam of coal. The following typical section at Tze-liu-ching is given by M. Coldre.

Tertiary sandstone, yellow, 100 to 300 ft. thick.
Limestone, gray.
Sandstone, red.
Oölite, orange colored, ferruginous, with petroleum at 600 feet.
Limestone, earthy white, fossiliferous.
Limestone, yellowish, fossiliferous, with weak flow of gas at 800 feet.
Marl, bluish gray, irridescent, white Permian chalk, with brine, 12 to 15%, at 1000 to 1800 feet.
Carbon or coaly, calcareous sandstone.
Brilliant brown Silurian sediments.
Schist, black, slaty.
Schists, greenish (Cambrian), with strong brine and strong flow of gas at 2500 to 3300 feet.

The strongest flows of brine and gas are found at these greater depths in the Tze-liu-ching district, and the upper brines, elsewhere important, are quite inconspicuous in this region. Owing to the disturbed condition of the strata, layers of basalt or red porphyry are sometimes encountered in drilling, and cause much difficulty.

Petroleum

Petroleum, gas, and brine all three, two, or only one of them may be found in any given well. Where the gas flow is strong the well is capped as noted later, when the gas is unimportant the petroleum and brine are drawn off together into reservoirs. The petroleum rises to the surface of the brine and is skimmed off. It is of a variety of colors. Some is milk white, pure enough to burn with a good light; a greenish white variety is less useful; a darker yellow still less; and a viscous black variety gives little light and much smoke. The Chinese know nothing of the art of refining this petroleum, and burn it just as it is in crude lamps, made so as to have no opening except that which is plugged by the wick, as the volatile hydrocarbons which remain in the oil are very inflammable. The Chinese also use the petroleum as an ointment in certain skin diseases and for rheumatism, just as the crude petroleum of Pennsylvania was at one time used. There are 30 to 40 of the petroleum wells in the Tze-liu-ching district and about 50 in the whole province of Ssu-chuan. It must be remembered that neither the petroleum nor gas are the objects of search by the Chinese, but are merely incidentally discovered in drilling for brine. It is quite possible therefore that petroleum may be found in much more abundant amounts if exploration is directed toward its discovery.

Gas

The gas is of more importance to the Chinese, as it is used in evaporating the brine. The gas is found at two horizons. The flow at 600 to 800 ft. in depth is not very strong and the gas from a single well, burning with a white flame, will only serve to heat 15 evaporating pans. But that which comes from a depth of more than 2000 ft. comes out in a strong flow, so that a single well will serve for heating 600 to 1200 of the evaporating pans, which are shallow segments of a sphere, 4 ft. in diameter and weighing about 1600 lb. each. The gas is not rich in carbon and burns with a blue flame, giving much heat and little light. The gas sometimes contains sulphur compounds. When the drill breaks through into the gas zone the pressure of the gas hurls it out of the drill hole, and occasionally the gas ignites, if any fire happens to be nearby. The putting out of a burning well calls for great ingenuity on the part of the Chinese, and is only accomplished with much expenditure of effort.

In order to use the gas supply of a well the drill-hole casing, described later, is removed to a depth of 10 ft. Then a truncated cone of heavy beams, the apex at the top, is placed over the drill-hole and earth mixed with lime is rammed down hard around it. This is covered with a lid of beams with a large spigot in the centre to allow the gas to escape while the arrangement is being connected. From beneath the lid numerous conduits made of hollow bamboos cemented together lead off to distributing reservoirs set about on the surface. These are made of lime cement, and are hemispherical in shape, a salt cake being used as the centre for the crown of the arch. From the side walls of this reservoir bamboo tubes lead off to the evaporating pots. Beneath these are conical stones with a hole in the centre through which the gas escapes, burning at the top. A good deal of gas escapes unburned into the air, and not a little leaks out at various places. Beggars sometimes dig a little hole at a crack in the ground near a gas well, light the gas which escapes, and do their cooking over it. In some places the flow of gas is more abundant than there is use for and the excess is led to a safe distance and there allowed to escape through a large burner, the flame rising to a height of 8 or 9 ft.

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In those gases in which the gas burns with a luminous flame it is used to some extent to illuminate the sheds where salt-making operations are carried on. It is not used for lighting the streets of the villages, as has sometimes been asserted. Some of the wells cease to yield gas after a time, in the ordinary way; others have been choked by the materials thrown into them by the rebels in a local rebellion. In this way one of the best wells has been ruined. By careful management, more efficient apparatus, and arrangements for piping gas and brine, so that the proportionate amounts of the two available at any one place come to be better adjusted to each other than at present, it would be possible to evaporate much more brine with the present supply of gas. M. Coldre has estimated that five times the present output could thus be made. At present other forms of fuel are used at those points where the gas is not convenient. All sorts of dried vegetable material are used for this purpose, corn stalks, pea and bean vines, marsh hay, and other materials of the same sort. Wood is not used much, since, as elsewhere in China, it is comparatively expensive. Coal, which is abundant in this province, but which usually occurs at some distance from the salt wells, is, however, used to a considerable extent.

Salt Wells

As already stated, the production of salt in this province is very great, and has been estimated at 1,000,000 tons per year, sufficing to meet the needs of the 70,000,000 people of the province and permit a brisk trade with adjacent regions. Those familiar with the salt industry in this country will at once notice that the Chinese do not use as much salt per capita as we do. M. Coldre has estimated the total number of salt wells as 10,000. The yield of brine from these wells is very unequal; thus the best well at Tze-liu-ching yields nearly 500 times as much salt as some of the other wells of the district. In some districts the wells average enough brine daily to keep five or six evaporating pans going. In other districts several wells are required to furnish brine enough to keep one pan going.

Drilling the Wells

The method of drilling and pumping these wells is so ingenious, and is so obviously the crude prototype of modern oil-well drilling that it is worth while to describe it in some detail, and the accompanying illustrations, reproduced from M. Coldre's paper in the *Annales des Mines,* will be of much interest in this connection.

Location of Wells.—There does not appear to be any scientific basis upon which the Chinese fix the location of proposed wells. The first wells were drilled near salt springs to increase their flow, and have spread outward, drilling having been done only in the vicinity of productive wells. The local wise men say they draw their inferences from the direction of the hills and the slope of the hillsides. It is quite possible that intelligent study of the areal geology would reveal one or more valuable unknown districts.

Drilling.—In starting a well a small round shaft is sunk to rock which is hard enough to stand the friction of the rope in drilling and the subsequent bailing. In the district we are discussing this shaft is commonly 100 ft. deep. This is then cased up with square rocks 2 or 3 ft. on a side through which a 10 or 12-in. hole has previously been cut. This is shown in Fig. 1, where three men are carrying such a casing stone toward a well which has just been cased to the top. As the stones are set in place the space between them and the shaft is filled with stones and well rammed earth. The hole is then rigged for the rope drilling which is to follow. A horizontal roller is rigged up at a convenient height to serve as a crown sheave. The winding drum, seen to the right in several of the pictures, is built of bamboo and is 8 to 12 ft. high and often 20 ft. in diameter. The construction of the wheel and the purpose of the sheave set midway between it and the hole is evident from the illustrations. The drilling is done with a 1-in. hemp rope and the construction of the drill bit is evident from Fig. 5 and Fig. 6. It is interesting to notice the double jars in Fig. 6, the sinker bar descending through them strikes a blow on top of the drill bit after it has struck its blow and comes to rest. The cord seen twisted about the string of tools in Fig. 5 is used to prevent loss of the drill bit, which weighs 200 to 300 lb., in case the jars break. The method of drilling is seen by referring to Fig. 7. The string of tools is hung from the key, which may be seen just above the mouth of the hole, which is suspended from a hook on the end of a lever made out of a thick plank. This is so adjusted that the lever is horizontal when the bit just touches the bottom of the hole. The four workmen then jump on the plank, depressing it and raising the bit a couple of feet. When they jump back on the side benches the bit falls. The man at the hole twists the string of tools in the usual way, and pours water into the hole when necessary. By jumping two at a time and passing from one side to another the men are able to drill at the rate of 12 to 15 strokes per minute. As the hole becomes deeper and the work harder, the number of men is increased up to 10 per shift. Two shifts are always on hand; each works 10 minutes while the other rests. The workmen were given their food and lodging and were paid 1200 cash (about $1.25) per month in 1891. The wages are probably somewhat higher now.

The operation of removing the sludge with a sand-pump, made of hollow bamboo weighing about 65 lb., is seen in Fig. 4. The men seen hanging on the rope are working the pump up and down to make it fill. Water is cased off with a bamboo tube. Fig. 9 shows the workmen making this tube, and Fig. 3 shows them lowering a section into the hole. This is 10 to 30 ft. in length and the joints are made water-tight with a cement made of tung oil and chalk. The rest of the drill rig is also built at this time. When the casing is securely in place, drilling is resumed with a smaller bit which makes a 3½ to 5-in. hole in some cases, but more often one which makes a 6½ to 8-in. hole. Deep drilling re-

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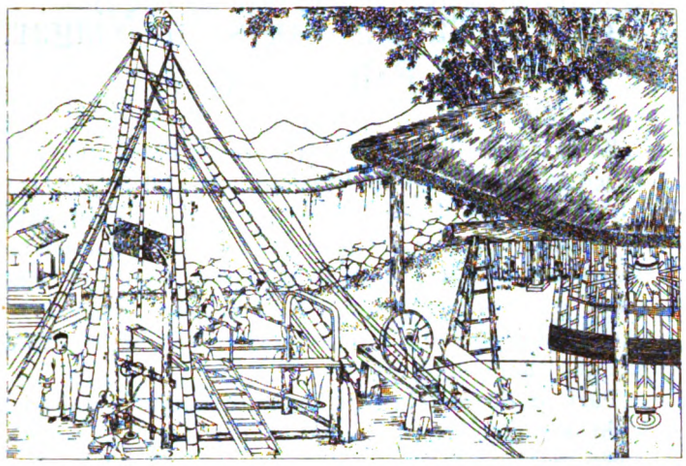

FIG. 7. REGULAR DRILLING OPERATIONS.

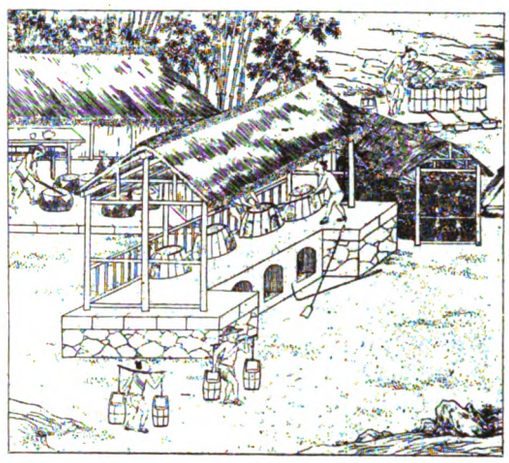

FIG. 8. EVAPORATING PANS FOR BRINE.

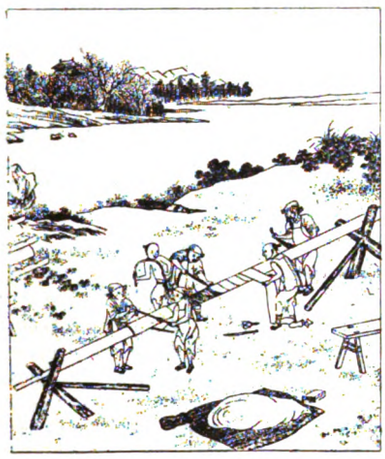

FIG. 9. MAKING BAMBOO CASING.

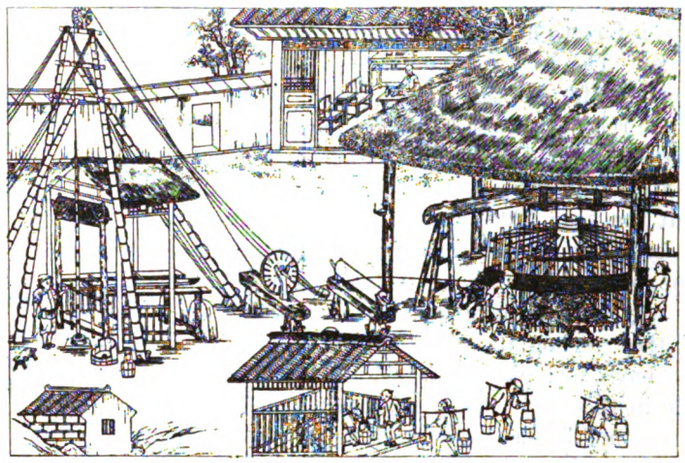

FIG. 10. HOISTING THE BRINE IN BAILERS.

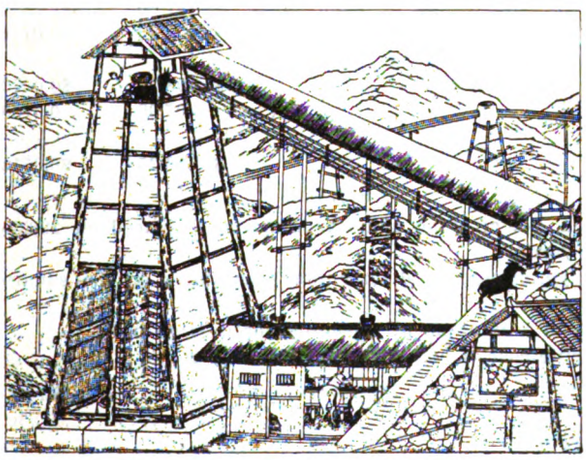

FIG. 11. ELEVATING WITH A CHINESE PUMP.

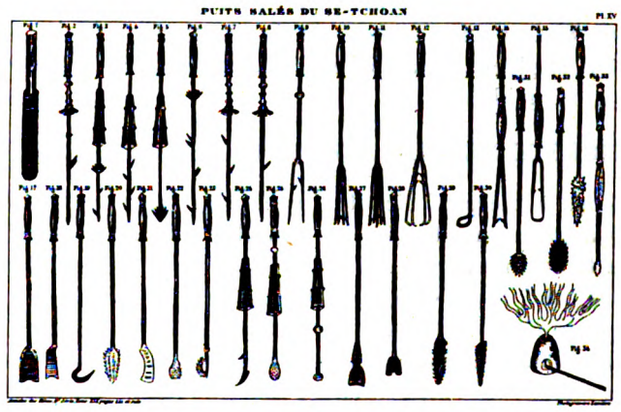

FIG. 12. FISHING TOOLS AND GAS BURNER.

quires the bit shown in Fig. 6. This is so constructed that the sinker bar, weighing 130 to 165 lb., strikes the top of the bit at each stroke, thus giving a double blow. At *K* is seen a small clapper which gives a sound which can be distinctly heard at the mouth of the well. When it is not heard, the man at the top knows it is time to let down more rope. Drilling continues in this way till the well is finished. The shallowest well in this district is 600 ft., the deepest 3500 ft.; most of them are 2500 to 2800 ft. deep. The cost of drilling a well is $6000 or more, according to the depth and the difficulties encountered, and is usually financed by a sort of joint stock company, which calls assessments as more funds are needed. Fig. 12, which shows

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some of the tools used in case of accident, needs no explanation.

SALT MAKING

The brine wells almost never flow, and they are pumped by the continual use of the sand-pump, using a special one, often nearly a hundred feet long, for this purpose. This is hoisted by the windlass, worked by water buffaloes, seen to the right in Fig. 8. These beasts are driven at a gallop by the liberal use of a rope's end, but they are poorly suited to moving at anything except a very slow rate. The cost of their keep is rather high for China, and they do not make a very efficient power plant. It would seem that a light, cheap steam hoist would be more satisfactory, or even an air-lift pumping plant for the most productive wells. The clarification of the brine, its evaporation in open pans, and the marketing of the salt would carry us too far from the limits of our theme, but it involves many interesting details and ingenious methods of procedure. The cast iron pans used for evaporating the brine are, for instance, not owned by the salt works, but are rented from the iron mongers, who replace them as soon as they show cracks or any other defects.

Marco Polo visited this part of China in his travels, about the year 1290, and in describing customs in this portion of Ssu-chuan makes the following observations: "The money matters of the people are conducted in this way. They have gold in rods which they weigh, and they reckon its value by its weight in *saggi*, but they have no coined money. Their small change is made in this way. They have salt which they boil and set in a mold (flat below and round above), and every piece from the mold weighs about half a pound. Now, 80 molds of salt are worth one *saggio* of fine gold, which is a weight so called. So this salt serves them for small change." As a *saggio* is $\frac{1}{6}$ oz., this would make the currency value of 1 lb. of salt at that time about 8½c. in our money. It is interesting to notice that Polo gives the rate of exchange there as 8 oz. silver for 1 oz. gold.

CONCRETE RESISTS IMPACT OF FALLING BODY

When a piece of elevator machinery weighing 3275 lb. was being hoisted to the roof through the skylight of a two-story portion of a bank building at El Paso, Texas, the rope carrying it snapped and the load dropped 85 ft. It fell upon a floor slab 5½ in. thick made of 1:2:4 concrete and provided with a main reinforcement of ½-in. square twisted bars spaced 6 in. o.c. and a temperature reinforcement of ⅜-in. square twisted bars, spaced 30 in. o.c. The result of this unexpected test was that a hole was made in the floor and that at a foot below the floor level the reinforcement held the piece of machinery. Practically no damage was done to the adjacent beam supporting the floor. Unexpected tests of this kind make one realize the strength of concrete and realize the abuse which it stands.—*Concrete-Cement Age.*

Road Surfacing Costs in Niagara Falls Park

Some interesting cost data were gathered and published in *The Canadian Engineer* by John H. Jackson, superintendent of Queen Victoria Niagara Falls park, in connection with a 5-mile stretch of macadamizing between Chippawa and Bridgeburg, Ontario. This work was included in the 1913 parking program of the commissioners. The following figures are from the 28th annual report.

Part of the mileage under construction required a light resurfacing, and another portion required the entire reconstruction of the top courses. For these two operations the following figures will show in detail the amounts that were spent per square yard:

The Light Resurfacing Water Bound Macadam Roadway

Time—August 5, 1913, to October 21, 1913.

Location—Boulevard roadway from Slater's dock, south.

Average length of haul—3.4 miles from M. C. R. siding, Chippawa.

Area treated—Length, 14,625 ft. = 2.77 miles; width, 18 ft. = 29,250 square yards.

LABOR	Total.	Per sq. yd.
Loading 2-in. stone and screenings	$ 232.56	$0.008
Hauling	442.95	0.0151
Pumping and watering	45.29	0.0015
Repairing roadway	275.18	0.0094
Rolling and spiking	97.29	0.0033
	$1,093.27	$0.0373
MATERIAL		
2-in. stone—205.5 tons at $1.25	$ 256.88	$0.0088
Screenings—150.2 tons at $1.00	150.20	0.0051
	$ 407.08	$0.0139
SUMMARY		
Labor	$1,093.27	$0.0373
Materials	407.08	0.0139
	$1,500.35	$0.0512

REMARKS

297 cu. yd. of stone and screenings were placed on 29,250 square yards.

1 cu. yd. of stone and screenings was placed on 98.5 square yards.

Ratio of 2-in. stone to screenings used—1 to 0.731.

Ton-mile cost of hauling materials—36.2 cents.

WAGE RATES	Per hr.
Teams	55c.
Laborers	22c.
Foremen	30c.

Cost per mile, $540.

The Heavy Resurfacing Water Bound Macadam Roadway

Time—August 1, 1913, to December 15, 1913.

Location—Boulevard roadway, from Black creek north.

Average length of haul—1.98 miles from Black Creek siding.

Area treated—Length, 14,467 ft. = 2.74 miles; width, 18 ft. = 28,934 square yards.

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Labor	Total.	Per sq. yd.
Loading 2-in. stone and screenings	$ 521.00	$0.018
Hauling	1,509.00	0.052
Pumping and watering	215.00	0.008
Repairing roadway	547.00	0.019
Rolling and spiking	425.00	0.015
	$3,217.00	$0.112
Material		
2-in. stone—750 tons at $1.10	$ 825.00	$0.029
Screenings—324½ tons at $1.10	357.00	0.012
	$1,182.00	$0.041
Summary		
Labor	$3,217.00	$0.112
Materials	1,182.00	0.041
	$4,399.00	$0.153

Remarks

895.4 cu. yd. of stone and screenings were placed on 28,934 square yards.

1 cu. yd. of stone and screenings was placed on 32.3 sq. yd. Ratio of 2-in. stone to screenings used—1 to 0.433.

Ton-mile cost of loading and hauling materials—32.3 cents.

Wage Rates	Per hr.
Teams	45c.
Laborers	20c.
Foremen	30c.

Cost per mile, $1600.

At Queen Victoria park rates for teams, 55c., and men 22c., the above ton-mile cost would be 38.4 cents.

In connection with the scarifying and re-crowning of this section of roadway, a bituminous top was laid on a 2¾-mile length, and the following figures show the cost of different operations in connection therewith:

Tarvia 'A' and Half-Inch Stone Surfacing

Time—September 2 to October 16, 1913.

Location—Boulevard roadway, vicinity of Usher's creek.

Length of haul—3.4 miles.

Area treated—Length, 14,625 ft. = 2.77 miles; width, 18 ft. 0 in. = 263,250 sq ft. = 29,250 square yards.

Depth—½ inch.

Labor Cost	Total.	Per sq. yd.
Loading, hauling, and placing stone	$ 861.05	$0.0290
Loading, hauling, and placing tarvia	353.71	0.0119
Placing and removing plant	56.50	0.0019
	$1,271.26	$0.0428
Material Cost		
½-in. stone—487.5 tons at $1.30	$ 633.75	$0.0214
Tarvia 'A'—14,307 gal. at 10c	1,430.70	0.0558
Freight, $188.35; demurrage, $32	220.35	
Soft coal for heating and operating roller	88.90	0.0030
	$2,373.70	$0.0802
Summary		
Labor	$1,271.24	$0.0428
Materials	2,373.70	0.0802
2.77 miles cost	$3,644.94	
1 mile cost	1,300.00	
1 sq. yd. cost	0.1230	

This was a carpet treatment undertaken with refined tar, known as Tarvia 'A.' The material was shipped in tank cars to the nearest railway siding, and heated by means of a steam boiler to a temperature of 100°F., when it was forced by steam pressure into the distributing apparatus, and then hauled to the site of the work, where it was attached to the steam roller. Connection was here made with the boiler and the material further heated to a temperature of between 175 and 200° Fahrenheit.

Steam pressure at 35 lb. per sq. in. was then applied to spray it upon the road surface. The apparatus used is supplied at the rear with nozzles so constructed that upon the application of pressure the hot material is forced to the surface of the road in a fine spray. The heated tar penetrates the top surface, and the remainder is then absorbed by means of ½-in. stone chips in the proportion of 1 cu. yd. over about 65 sq. yd. of surface, giving a depth of stone and tar equal to a little over ½ in. The quantity of bituminous material for this treatment was ½ gal. to the square yard, and as indicated, the total cost, including labor, was 12.3c. per square yard, or about $1300 per mile for an 18-ft. roadway. It is estimated that the only cost of upkeep to this surface will be an annual tar spraying of about ⅛ gal. per square yard, at a cost of between 3 and 4c. per square yard, or about $320 per mile for an 18-ft. roadway.

In comparison with the heavy water bound macadam resurfacing, it is interesting to note the details of figures for extra heavy resurfacing with a chemical binder. The following figures show the details of cost for a Rocmac resurfacing upon the main driveway of the park where the road metal was 4 inches in thickness:

Rocmac Resurfacing at Rambler's Rest

Time—May, 1913.

Location—Main driveway, opposite Rambler's Rest loop.

Length of haul—3400 ft. = 0.644 mile (from Victoria Park siding).

Area treated—Length, 370 ft.; width, 21 ft. = 7760 sq. ft. = 863 square yards.

Depth removed—4 inches.

Material removed—370 ft. × 21 ft. × 4 in. = 2590 cu. ft. = 96 cu. yd. (in place).

Labor Cost	Total.	Per sq. yd.
Removing old surface (96 cu. yd.)	$ 97.20	$0.1126
Hauling 144 cu. yd. of stone and screenings from Victoria Park station	119.08	0.1380
Resurfacing	63.16	0.0731
Rolling	28.00	0.0325
Foreman	60.20	0.0697
	$ 367.64	$0.4259
Material Cost		
2-in. stone, 114 cu. yd.—136.8 tons at $1.25	$ 171.00	$0.1982
Screenings, 30 cu. yd.—36 tons at $1	36.00	0.0417
Rocmac solution, 374 gal. at 45c	168.30	0.1950
	$ 375.30	$0.4349
Summary		
Labor	$ 367.64	$0.4259
Material	375.30	0.4349
	$ 742.94	$0.8608

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Determination of the Maximum Storm-Water Flow*

By C. E. GRUNSKY†

While intended to apply specifically to urban and suburban areas for which storm-water drains are to be provided, the formulas here presented have a wider application. The element of greatest uncertainty in any formula for the maximum run-off rate will always be the effect of the perviousness of portions of the surface of the watershed upon this rate. The allowance for this effect will be made by the engineer on the basis of experience.

Notation: Let

A represent the area in acres of the watershed under consideration.

$A_1\ A_2\ A_3$ represent subdivisions of this watershed, also expressed in acres.

a be the coefficient of perviousness of the surface of the entire watershed.

$a_1\ a_2\ a_3$ be the coefficients of perviousness of the respective subdivisions of the watershed.

T represent the time in minutes that it will take water, under maximum run-off conditions, to flow in the conduits which are to be provided from the most remote part of the watershed to the point at which the maximum storm-water discharge is to be determined.

t represent the critical time in minutes during the continuance of a rainstorm for the area under consideration, being that time within which the falling rain will produce maximum discharge.

i be the number of minutes which it takes for water to flow across the surface of the area under consideration to an entry into the conduits.

I represent the maximum average rainfall intensity expressed in inches per hour during any t minutes.

R represent the maximum amount of rain to be expected in any one hour.

C represent a constant. While the value of C is unchangeable for any locality, it varies for different localities with the varying values of R.

It will be found to be generally true that:

$$I = \frac{C}{\sqrt{t}} \qquad (1)$$

$$R = \frac{C}{7.75} \qquad (2)$$

$$C = I\sqrt{t} \qquad (3)$$

$$R = \frac{I\sqrt{t}}{7.75} \qquad (4)$$

$$I = \frac{7.75\,R}{\sqrt{t}} \qquad (5)$$

These formulas, with the aid of local rainfall records, will permit of a determination of values of R and of C. The maximum amount of rain which may be expected in 30 minutes, 1 hour, 2 hours, or some other period or periods, may be used for this determination. The endeavor should be to select these maxima as they apply to the whole watershed which is under consideration. Single station records do not, as a rule, correctly indicate what is happening in watersheds of considerable area. Some allowance for this fact may have to be made.

The formula (1) for rain intensity as above noted is an empirical formula which will be found closely to approximate the actual facts in any locality if the value of C be correctly determined.

To find the maximum run-off rate from any watershed, proceed as follows:

Divide the watershed having an area of A acres into 3 subdivisions, A_1, A_2, A_3, such that the time required by water to flow from the farther limits of the first in conduits of the type to be provided will be one-third, and that the time required for water to flow from the farther limits of the second will be two-thirds of the time required for water to flow from the most remote part of the watershed to the point for which maximum storm-water flow is to be determined.

Approximate the time in minutes i that it will take water to flow across the surface of the ground to the inlets of the conduit system.

Then estimate the critical time t from the following:

$$t = 0.40\frac{T}{aA}(a_1A_1 + 2a_2A_2 + 3a_3A_3) + i \qquad (6)$$

The factor a is found from the following:

$$a = \frac{a_1A_1 + a_2A_2 + a_3A_3}{A} \qquad (7)$$

In determining values for a_1, a_2, a_3 consideration must be given to the perviousness of the surface. For an entirely impervious surface these factors would be unity. For a coarse, well underdrained gravel they might be zero. The value of a, a_1, a_2, a_3 will therefore lie somewhere between one and zero.

The well known engineer, Emil Kuichling, recommends:

For:	Value of a.
Roof surfaces	0.70 to 0.95
Asphalt pavements in good order	0.85 to 0.90
Stone, brick, and wooden block pavements with tightly cemented joints	0.75 to 0.85
Same with open or uncemented joints	0.50 to 0.70

*A complete theoretical discussion of the storm-water flow problem will be found in the *Transactions* of the Am. Soc. C. E., Vol. LXV, p. 310 *et seq.*

†Consulting Engineer, Mechanics Institute Bdg., San Francisco.

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Inferior block pavements with uncemented joints	0.40 to 0.50
Macadamized roadways	0.25 to 0.60
Gravel roadways and walks	0.15 to 0.30
Unpaved surfaces, railroad yards, and vacant lots	0.10 to 0.30
Parks, gardens, lawns, and meadows depending on surface slope and character of the subsoil.	0.05 to 0.25
Wooded areas or forest land depending on surface slope and character of the subsoil	0.01 to 0.20

It is believed, in applying the formulas here presented, that it would be better in most cases not to attempt the minute distinction recommended by Mr. Kuichling in the case of surfaces that are impervious or nearly so. These should preferably all be considered as impervious and therefore for them a should be taken at unity.

Based on the population per acre and the assumption that the soil of the country is an ordinary loam, the approximate values which are given in the following table may be used:

Population per acre.	Value of a.	Population per acre	Value of a.
10	0.20	60	0.60
20	0.30	70	0.65
30	0.40	80	0.70
40	0.50	90	0.73
50	0.55	100	0.75

The maximum storm-water flow in second-feet per acre is now to be estimated by the formula:

$$q = \frac{5\,a\,R}{\sqrt{t}} \text{ second-feet per acre} \qquad (8)$$

In developing this formula, consideration has been given to the effect upon the momentary discharge of the temporary water storage in the conduits and upon the surface of the ground. This is fully explained in the paper already referred to.

Formula (8) may also be written:

$$q = 0.645\,a\,I \text{ second-feet per acre} \qquad (9)$$

In this form the storm-water flow formula will be found convenient for use, particularly if recourse be had for values of I to the diagram Fig. 1, or to Table I in which maximum rain intensity is noted for time periods up to 24 hours and for a number of values of C.

In the table the rain intensity is expressed in inches per hour for the time t. The value of the constant C which appears in the rain intensity formula is dependent upon local rainfall conditions. Local records, or if no local records are obtainable, then those of some locality most nearly in correspondence, are to be used, as already explained, for introduction into the formulas for maximum intensity of rain, for the constant C, and for the maximum amount of rain in one hour.

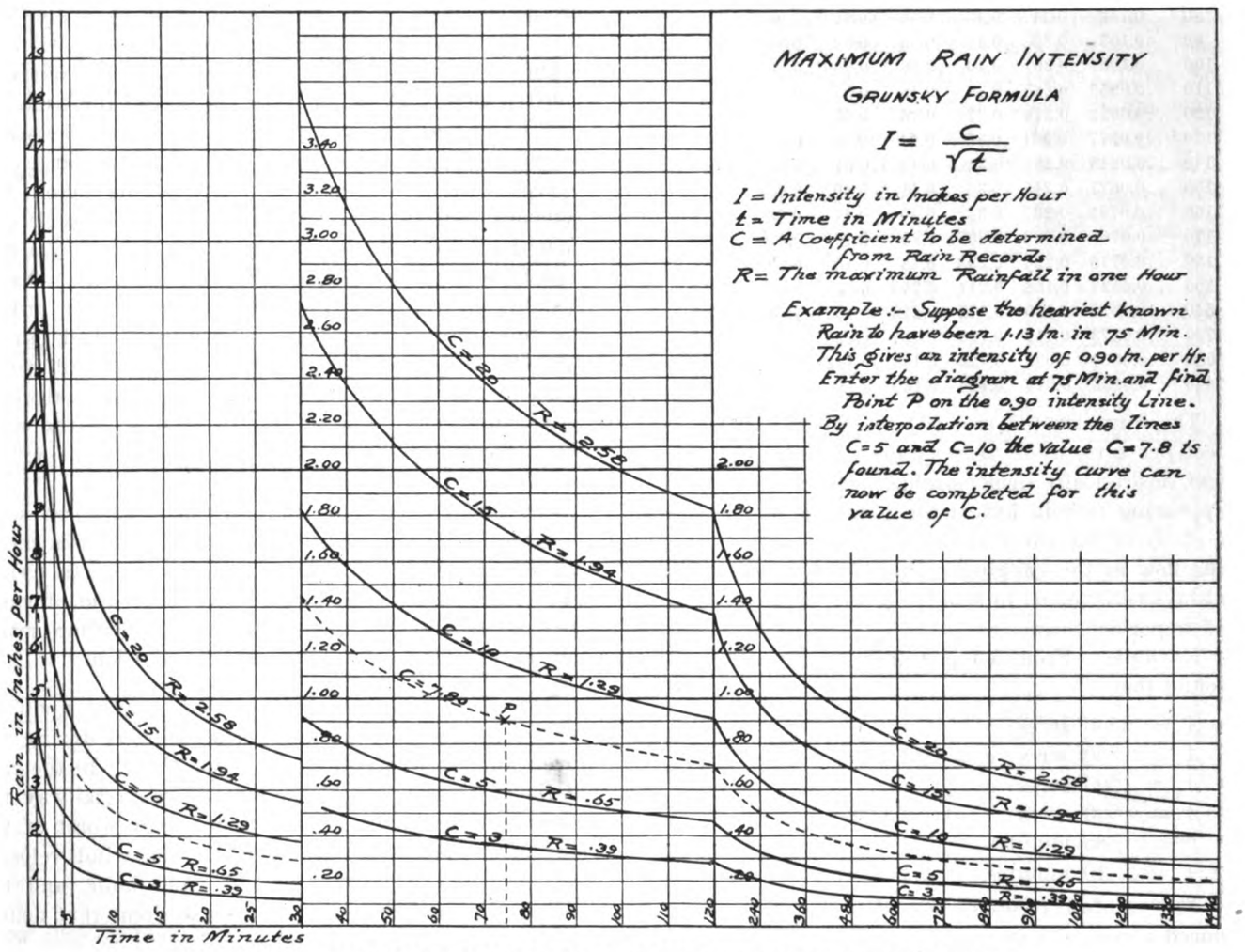
MAXIMUM RAIN INTENSITY
GRUNSKY FORMULA
$I = \frac{C}{\sqrt{t}}$
I = Intensity in Inches per Hour
t = Time in Minutes
C = A Coefficient to be determined from Rain Records
R = The maximum Rainfall in one Hour
Example:- Suppose the heaviest known Rain to have been 1.13 In. in 75 Min. This gives an intensity of 0.90 In. per Hr. Enter the diagram at 75 Min. and find Point P on the 0.90 intensity Line. By interpolation between the lines C=5 and C=10 the value C=7.8 is found. The intensity curve can now be completed for this value of C.
C=20 R=2.58
C=15 R=1.94
C=10 R=1.29
C=7.8
C=5 R=.65
C=3 R=.39
P
Rain in Inches per Hour
Time in Minutes

CHART FOR CALCULATING MAXIMUM RAIN INTENSITY ACCORDING TO GRUNSKY'S FORMULA.

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TABLE I

MAXIMUM RAIN INTENSITY—GRUNSKY FORMULA

$$I = \frac{C}{\sqrt{t}} \text{ inches per hour.}$$

Time in min.	$\frac{I}{\sqrt{t}}$	Rain intensity expressed in inches per hour. $C=3$	$C=4$	$C=5$	$C=6$	$C=8$	$C=10$	$C=15$
1	1.000	3.00	4.00	5.00	6.00	8.00	10.00	15.00
2	0.707	2.12	2.83	3.54	4.23	5.64	7.07	10.60
3	0.577	1.73	3.31	2.89	3.45	4.61	5.77	8.65
4	0.500	1.50	2.00	2.50	3.00	4.00	5.00	7.50
5	0.447	1.34	1.79	2.24	2.68	3.57	4.47	6.60
6	0.408	1.22	1.63	2.04	2.45	3.26	4.08	6.10
8	0.353	1.06	1.41	1.77	2.12	2.82	3.53	5.30
10	0.316	0.95	1.27	1.58	1.90	2.53	3.16	4.74
12	0.289	0.87	1.16	1.45	1.73	2.31	2.89	4.33
14	0.267	0.80	1.07	1.34	1.60	2.13	2.67	4.01
16	0.250	0.75	1.00	1.25	1.50	2.00	2.50	3.75
18	0.236	0.71	0.95	1.18	1.42	1.89	2.36	3.54
20	0.224	0.67	0.90	1.12	1.34	1.79	2.24	3.36
25	0.200	0.60	0.80	1.00	1.20	1.60	2.00	3.00
30	0.183	0.55	0.73	0.92	1.10	1.46	1.83	2.75
35	0.169	0.51	0.68	0.85	1.01	1.35	1.69	2.54
40	0.158	0.47	0.63	0.79	0.95	1.26	1.58	2.37
45	0.149	0.45	0.60	0.75	0.90	1.20	1.49	2.24
50	0.141	0.42	0.57	0.71	0.85	1.13	1.41	2.12
55	0.135	0.41	0.54	0.68	0.81	1.08	1.35	2.03
60	0.129	0.39	0.51	0.65	0.77	1.02	1.29	1.94
70	0.119	0.36	0.48	0.60	0.71	0.95	1.19	1.79
80	0.112	0.34	0.45	0.56	0.67	0.90	1.12	1.68
90	0.105	0.32	0.42	0.53	0.63	0.84	1.05	1.58
100	0.100	0.30	0.40	0.50	0.60	0.80	1.00	1.50
110	0.0953	0.285	0.38	0.48	0.57	0.76	0.95	1.43
120	0.0913	0.274	0.37	0.46	0.55	0.73	0.91	1.37
130	0.0877	0.264	0.35	0.44	0.53	0.70	0.88	1.31
140	0.0845	0.254	0.34	0.43	0.51	0.68	0.85	1.27
150	0.0817	0.245	0.33	0.41	0.49	0.65	0.82	1.22
160	0.0791	0.237	0.32	0.40	0.47	0.63	0.79	1.19
170	0.0767	0.230	0.307	0.39	0.46	0.61	0.77	1.15
180	0.0745	0.224	0.298	0.38	0.45	0.60	0.75	1.12
360	0.0527	0.158	0.211	0.264	0.32	0.42	0.53	0.79
540	0.0430	0.129	0.172	0.215	0.258	0.34	0.43	0.65
720	0.0373	0.112	0.149	0.187	0.225	0.30	0.37	0.55
1080	0.0304	0.091	0.122	0.152	0.182	0.243	0.30	0.46
1440	0.0263	0.079	0.105	0.132	0.158	0.210	0.263	0.40

The formulas (8) and (9) for the run-off in second-feet per acre, while very simple in form, are nevertheless theoretically demonstrable. The numerical factors appearing therein have been deducted, as stated, from a study of the effect of the water still in transit, upon the flow at the gauging point. The factor which will always be involved in some uncertainty is the coefficient of imperviousness.

Example: From a topographical survey it has been found that

$A = 2500$ acres;
$A_1 = 500$ acres; $a_1 = 0.90$
$A_2 = 1200$ acres; $a_2 = 0.75$
$A_3 = 800$ acres; $a_3 = 0.40$
$T = 85$ minutes
$i = 10$ minutes.

The rainfall records show that one rainstorm produced a rain of 1 inch in 2 hours, and another 2 inches in 6 hours. It is known that the storms in which these amounts fell were exceptionally severe and that both records may be regarded as maxima. In view of the fact that both of these are single station records and that results deduced therefrom are to be applied to a large area, the values of R and of C determined therefrom will be applicable to the entire area with some safety margin.

It is known, then, that for 2 hours, or 120 minutes, the rain intensity has averaged 0.50 in. per hour. It is known, too, that for 6 hours the rain intensity has averaged 0.33 in. per hour.

CONCRETE FOR IRRIGATION

The lining of irrigation canals with concrete in order to prevent losses in the transmission of water is discussed at some length in a forthcoming bulletin of the U. S. Department of Agriculture (No. 126) entitled 'Concrete Lining as Applied to Irrigation Canals.' The census of 1910 shows that there were more than 120,000 miles of unlined irrigation canals in the West. Forty per cent of the water that passes through this, the author estimates, is lost, or, if allowance be made for that which is later recovered by lower conduits, the loss is still more than 25%. So much of this loss could be obviated by the use of concrete that in many places the value of the water will more than offset the increased cost of construction.

On the larger irrigation systems now in course of construction, water rights are being sold for from $25 to $50 per acre. In addition to the value of the water saved by concrete lining, the reduction in charges for operation and maintenance must also be taken into consideration; and also the insurance that such construction affords against damage to the crops by a sudden failure on the part of the water supply. As an instance of the importance of the latter, the author mentions a break in a canal in California which caused 1000 ft. of the main canal on a steep side-hill to be washed out. It was six weeks before the canal could be repaired, and, although the actual cost of the work was only $20,000, the loss to the crops from lack of water was estimated at $1,000,000.

The bulletin presents in a summarized form some results of seepage measurements, and discusses methods and costs of concrete lining as applied to irrigation channels. It is a professional paper and of value to engineers and others engaged in irrigation work, and is not intended for general distribution.

One of the most severe tests yet inflicted upon reinforced concrete telegraph poles occurred during the recent blizzards in and around New York. In the case of the telegraph line of the Pennsylvania railway the concrete poles were exposed to the very worst of the storm, and emerged successfully. The wind velocity in many places reached 80 miles per hour, and the accumulation of snow and ice was so great that nearly every overhead line was broken down. In no case, however, was the failure of a concrete pole recorded.

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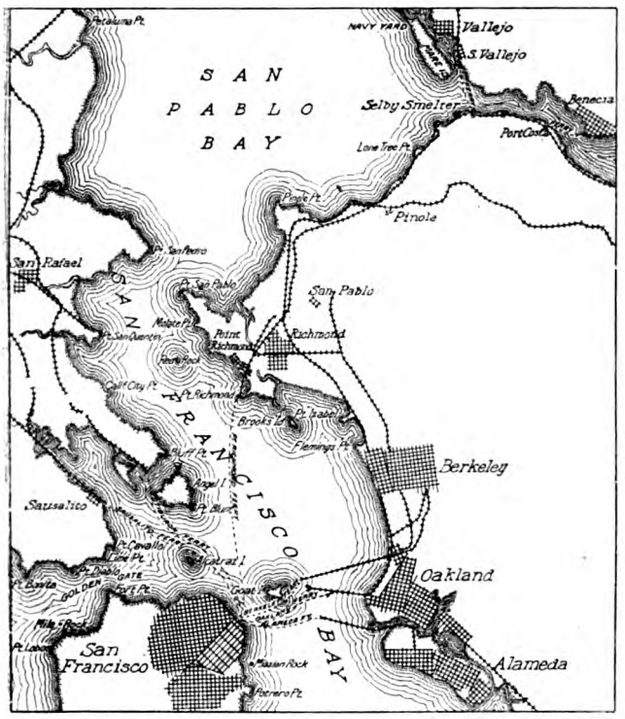
Blasting by Wholesale

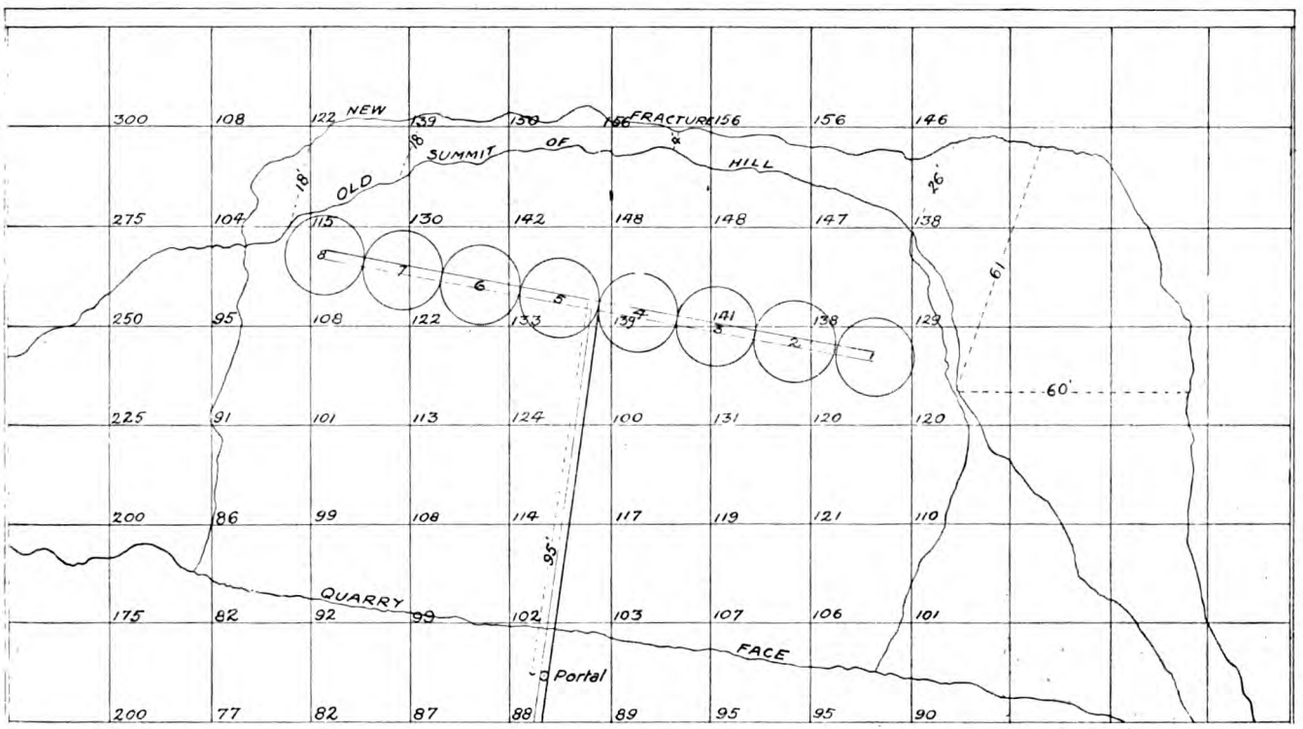
By M. W. von BERNEWITZ

A large quantity of rock is quarried from various points in the north part of San Francisco bay, California. This is used for concrete construction, roads, filling for the waterfront, and other purposes, being loaded on skip and hopper barges and towed to various points as desired. For filling in part of the waterfront on the San Francisco side of the bay, and constructing part of the new two-mile mole for the Key Route electric train system on the Oakland side, the Daniel Contracting Co. is supplying about 1,000,000 tons of rock. This is excavated at the firm's quarry at McNear's point, about an hour by water from the city. Here is a fully equipped plant consisting of three Bucyrus steam-shovels, each capable of handling 1000 to 1300 cu. yd. of rock in 10 hours, a railroad system with light locomotives and side-dump cars, and electric dumping apparatus which can fill a skip barge of 250-ton capacity in about an hour. Hopper barges carry up to 900 tons each, and may be filled at a greater proportionate rate.



PART OF SAN FRANCISCO BAY. THE QUARRY DESCRIBED IS AT SAN PEDRO POINT.

In order to have plenty of rock for the shovels, large quantities of material are broken at the two faces being worked. One is a brown and the other a blue metamorphic sandstone, the latter being the hardest. On July 11, 1914, a large blast was made at the brown face, which kept the shovels supplied for over two months. As will be seen from the plan, an adit was driven into the hill 95 ft., from which cross-cuts were driven 70 ft. each way. These were only large enough to enable a machine-drill to be worked, and to wheel out the rock broken. The cross-cuts were divided into four sections each, and were charged with powder. This is received in 12.5-lb. bags, with 4 bags to a 50-lb. case, and is special powder for such large blasts. Three No. 7 electric exploders were inserted in each charge, making 24 in all. Leads to convey the electric current for exploding consisted of No. 14 insulated wire, laid in 2 by 4-in. grooved boards and connected in straight series.



PLAN SHOWING ELEVATIONS, ADITS, CROSS-CUTS, POWDER ARRANGEMENT, OLD AND NEW SUMMIT OF HILL. THE FIGURES GIVE ELEVATIONS ABOVE SEA-LEVEL.

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The charges were well tamped with fine and large rock, and the adit filled to the portal. Laying the powder and tamping took about four days, and was supervised by J. C. Costello of the California Trojan Powder Co. Each section was charged with powder made by this Company, as follows:

Load.	No. 2 powder, pounds.	No. 4 powder, pounds.	Total, pounds.
1	2,250	....	2,250
2	2,300	....	2,300
3	2,500	....	2,500
4	....	2,250	2,250
5	....	2,250	2,250
6	....	1,900	1,900
7	....	1,900	1,900
8	450	1,700	2,150
Total	7,500	10,000	17,500

To help the main blast by cutting away the foot of the hill, so as to allow the broken rock to slip down, eight 22-ft. holes were bored at equal distances by a machine with 1¼-in. drills. These 'toe-blasts' were fired first, and so loosened the bottom. In setting off the large charge, a 220-volt, 110-ampere electric current was switched on to the leads. At the moment of disruption, as shown by the halftone, the whole hill was lifted out several feet, fell back, and then the broken rock started to roll down. There was only a dull thud heard, more noise being caused by rolling of rocks than the actual explosion. In the plan will be seen the old summit of the hill and new line of fracture, in one place 61 ft. apart. The blast was an excellent one, and a total of 166,250 tons of rock, well broken up and requiring no secondary blasting, has since been moved by the steam-shovels, and dumped into San Francisco bay. Each pound of powder broke 9.5 tons of rock.

In wholesale mining, where the conditions are similar, this system of blasting, known as the 'coyote,' should be satisfactory.

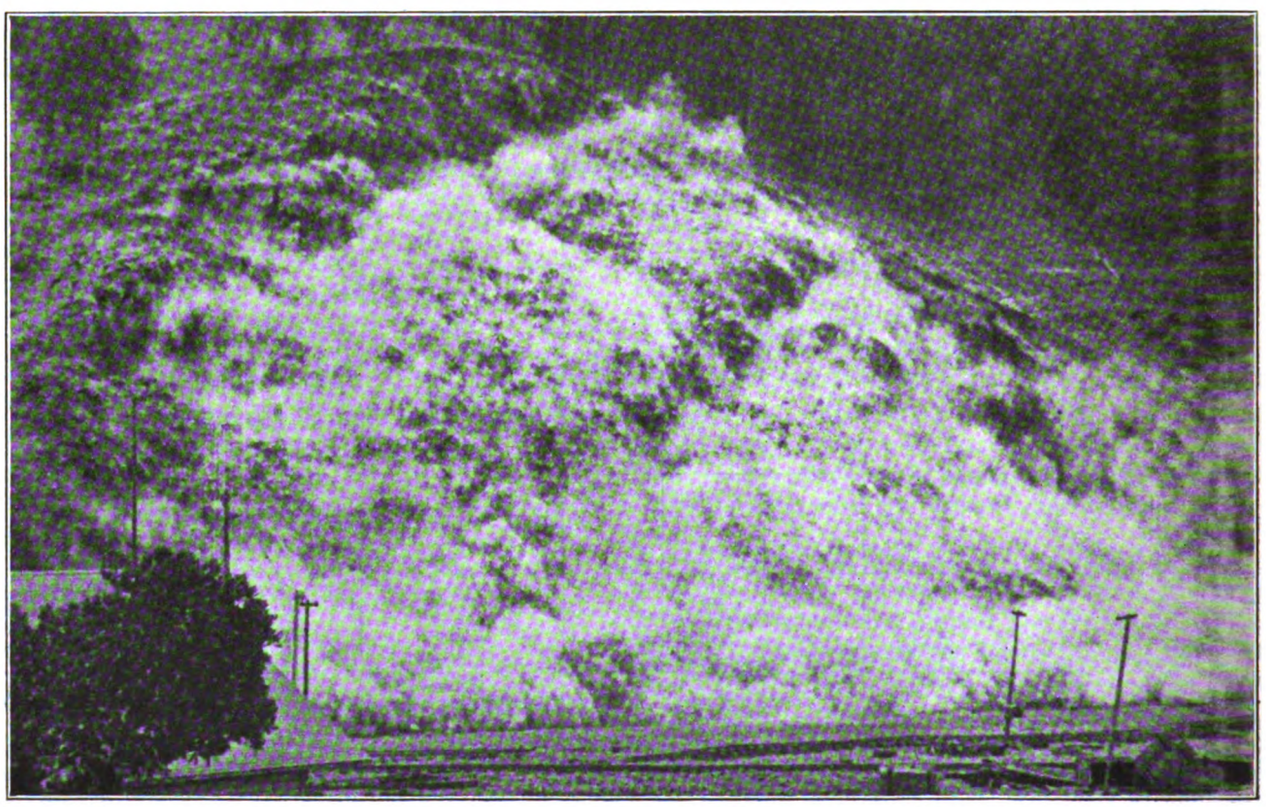
According to the California State Mining Bureau, there were 182 quarries operated in 42 counties of the state in 1913, and probably an equal number were idle. The output was valued at $6,168,020, against $5,473,928 in 1912. The quantities of crushed rock were as follows:

Classification.	Tons.	Value.
Macadam	1,533,330	$ 885,638
Rubble	686,983	361,079
Concrete	931,098	607,194
Unclassified	3,268,142	1,988,876

Marin county, in which is the quarry described in the article on blasting on the preceding page, produced 421,032 tons of rubble in 1913.

Sand and gravel produced totaled 3,393,268 tons, worth $972,694; paving blocks, 6,364,000, worth $363,505; and granite for various purposes, 1,324,835 cu. ft., worth $729,277.

The proper amount of water to be used in mixing concrete is that amount which will produce a mixture of the specified consistency. The consistency of the mixture should be carefully watched, and not the dose of water.



THE BLAST AT THE MOMENT OF DISRUPTION. ENLARGED FROM A MOVING PICTURE FILM. ROCKS CAN BE SEEN IN THE AIR.

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Irrigation

By CHARLES KIRBY FOX*

Irrigation, the artificial watering of crops, was practised extensively by the civilized ancients both in the Old and New World. In the United States it is probable that the first extensive irrigation systems outside of the smaller Indian and Spanish systems, were constructed by the Mormons in Utah, beginning about 1848. For several decades the growth was slow, until in 1889 the irrigated area in the United States, as reported by the Census Bureau, was 3,631,381 acres; in 1899 it was 7,518,527 acres; in 1909 it was 13,738,485 acres, and now is probably around 18,000,000 acres. Many estimates have been made of the probable amount of land which will be irrigated in the United States, the minimum usually being about 50,000,000 acres. In southern Europe, Egypt, India, China, Australia, and Latin America there are many million acres of successfully irrigated land and much more in prospect.

The first systems were small ditches, usually individual; then came the smaller companies and coöperative systems, later the larger companies, irrigation and Carey Act projects; and finally the Reclamation Service. By far the largest amount of land has been placed under irrigation in the United States by private partnership and coöperative ditches. For some time to come, outside of the relatively smaller area which is irrigated from wells, it will be necessary to depend upon the larger organizations and government aid on account of the immense capital required.

The unirrigated land in the arid regions is practically valueless, not on account of the character of the soil, but because of the absence of the all-important factor, the life-giving substance, sufficient moisture. Land which cannot find takers at the government price of $1.25 per acre will immediately jump to five or ten times that price on the slightest pretense that irrigation will be provided. Ordinary irrigated land suitable for the various field crops sells for $100 to $200 per acre, and where permanently adapted for intensive farming of fruit, seeds, and truck, may bring $2000 to $3000 per acre.

The cost, difficulties, and time required to bring the land under cultivation have usually been greatly underestimated. It is also true that the first year or two on an irrigated farm is very trying for most farmers, but will not compare with the hardships and privations of the early pioneers. It has been said many times that there is more evidence of progress, such as roads, railroads, schools, and telephones during five or six years in an irrigated district than in an unirrigated district in 30 to 50 years.

There has been a great deal of discussion of the relative returns and value of humid and irrigated arid lands. There are many factors entering into this problem, but as near as I can judge an acre of irrigated land in an arid region is worth two in a humid region Irrigated lands require far more intensive farming.

To buy the house, barn, horses, and machinery for a small farm, say 80 acres, will cost several thousand dollars. Then comes the cost of living, clearing, leveling, and putting in the crops, which will often bring this up to around $5000 before a dollar of returns can be expected. Often farmers with small capital will take several years to cultivate a farm. When the farm is in running order the usual rate of income is 20 to 30%, which is richly deserved.

It has been suggested, with a view to facilitate and hasten settlement, that the water organizations arrange to clear and level the land, which they could do probably far more cheaply than the settlers, lend the settler a stated sum for each 10 acres he puts in crops, or extend their payments over a longer period of time, preferably without annual payments for the first few years. All of these suggestions have merit. Of course, it would take a larger capital, but the entire investment would commence to pay more quickly.

Rapid colonization by experienced farmers of moderate means is important. For example, consider land selling for $50 per acre, taking an average of three years to get under cultivation. Assume compound interest at 6% or a total of $9.50 per acre, whereas if development were slow, say 10 years, the interest would amount to $39.50 and many of the temporary structures would have to be replaced.

It is absolutely necessary that the lands should be capable of producing valuable crops under good drainage conditions; that the locality be climatically and geographically favorable; and that satisfactory market and transportation facilities exist or can be provided. The land should be so situated that an economical distribution system can be constructed.

As a general rule the lands of the so-called arid regions are rich in the so-called earthy constituents of plant life, but occasionally contain an excess of alkali, which shows on the surface after rains and can be remedied by drainage or an application of gypsum. Usually the lands are deficient in nitrates, which can be remedied with leguminous crops.

It is my practice when reporting on irrigation projects to classify the lands into three grades: first, absolutely first-class land; second, lands with various minor defects; third, lands which are practically valueless for irrigated farming under present conditions. Land which is at present irrigated or probably will be irrigated from other sources is also classified under a subheading of the third class and eliminated from further discussion.

If the water rights and lands belong to the same company, I estimate on selling practically all of the first and second-class lands, but if the water rights and lands are owned by separate and distinct parties, for instance the water rights by an irrigation company and the lands by small private holders, I only estimate on selling and receiving payment for 75 to 90% of the

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first and second-class lands, depending upon the local conditions.

Transportation is an important factor and is frequently overlooked by many land seekers. In the West, freight rates on the main trunk lines frequently average around 1c. per mile; farther in the interior the rates are higher, and on branch lines average around 3 to 4c. per ton-mile, while on narrow-gage railroad lines frequently average around 7c. per ton-mile. Wagon hauling usually costs 20 to 30c. per ton-mile. Water transportation is very cheap.

To illustrate the point further, consider a farm 10 miles from the railroad station, with 100 miles of branch line and 300 miles of main line railroad hauling. This would cost the farmer, say, $9 per ton to land his product in the market, whereas a farmer more favorably situated, having a farm, say, 2 miles from the station, with water and rail transportation facilities competing and 100 miles from the market would only have to pay around $1.50 per ton. This would be a saving of $7.50 per ton, or at 5 tons per acre, $37.50 per annum per acre, which would pay interest on a much higher land valuation. Railroad rates vary so much, due to different classification and length of haul that this can only be considered an extreme case, nevertheless it illustrates the principle involved. The transportation question is usually taken care of by varying the crop or product. Thus near the markets where transportation is cheap and efficient, garden truck and fruit are raised, while farther away the products are hay and grain. In the back country, cattle can be driven to market nearly as cheaply as they can be carried on the railroad.

Nearness to market is also important, aside from the cost of transportation, as it provides the ability to ship quickly so as to command top prices and offers many other conveniences.

The available supply of water is probably the greatest single factor involved, and will limit irrigation development. The United States government maintains a water resources branch of the Geological Survey which has made measurements of the run-off over a varying period of years for the most important streams in the country. These records are usually reliable, and it is to be regretted that they are not more extensive and cover periods of longer duration. Estimating the run-off from the rainfall is very hazardous, but often has to be done. Run-off is usually measured in acre feet, that is, the amount of water required to cover 1 acre 1 ft. deep, which is equivalent to 43,560 cu. ft., 325,850 gal., or 1360 tons. A cubic foot of water per second is ordinarily called a second-foot. A cubic foot of water is equal to 7.48 gal. and weighs 62.5 lb. A second-foot of water flowing 12 hours is equal to approximately 1 acre-foot.

The net amount of water required for crop maturing varies with the crops, length of growing seasons, number of irrigations required, soils, amount and distribution of rainfall, sunshine and temperatures, and many other conditions, usually being from 1 to 5 acre-feet per acre per annum. In addition to this it is necessary to add a sufficient allowance for seepage and evaporation in the canals and laterals and reservoir. Unfortunately this may amount to as much water as is used on lands.

The legal status and titles are fully as important as sufficient available quantities of water. The riparian or common English law has been rightly rejected in most of the arid states *in toto*, and doubtless will be in many others soon. The status of irrigation law was formerly uncertain and litigation expensive, but now most arid states have a state engineer or water commission to look after irrigation matters. This has greatly strengthened titles and lessened if not almost entirely eliminated litigation.

Irrigation engineering is now on a substantial basis. It is customary to take sufficient time to make detailed studies of water and storage available, various structures and canals, their location, alternate designs, and comparative estimates, with the result that accurate, complete, dependable plants and estimates are available before construction is started.

When irrigation started, $5 per acre was considered to be the limit of cost for large irrigation systems. By 1900 it had risen to $10 or $15 per acre, and now $25 to $50 or more per acre is not considered prohibitory if the other conditions are right. These figures relate to the actual construction cost, while the selling price is usually two or three times as much. Maintenance charges usually average around $1 per acre.

It has been rightly said that a few of the irrigation projects will result in a loss to the investors and that few of them have 'panned out' as the promoters planned. Too often it was represented that the construction cost was the only large expenditure, whereas there was promotion, obtaining water rights, surveys, designs, estimates, reports, and legal fees before construction started. Then came the actual construction, costs of selling water rights, discount and interest on bonds, general and overhead charges, and development costs. Those so-called and often unexpected outside charges often amount to as much as the construction cost, and seldom less than 50% thereof, and do not include buying and preparing the land that is included in the project.

I believe the principal difficulty of irrigation financing in the past has been that returns were expected too soon. The same statement would doubtless apply to most development projects. Some plan must be devised to reduce the heavy so-called fixed charges during the development stage and give the project time to get on its feet.

The actual cultivation of the lands under the existing completed ditches has proceeded at a very rapid rate during the past few years, whereas the construction of new projects has almost been at a standstill. The only exception to this statement has been the Reclamation Service work.

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Engineers' Note Book

Steam Piping Chart

By H. D. AUSTIN*

The graphical method can often be employed to advantage in the solution of many ordinary engineering problems. This method is especially applicable to the solution of problems where the engineer is working up a tentative plan, as it enables him to revise his work easily and quickly without recourse to a complicated and tiresome mathematical calculation, which in the end may lead to an unsatisfactory design necessitating further study and calculation. Under this title the problem relative to the proper size of pipe required to deliver a given quantity of steam at a given pressure, and a definite loss in pressure may be classed. In this problem the loss in pressure is generally assumed, and it may require several trials before the most economical size of pipe and loss in pressure is determined. For the solution of steam problems of this character, the writer submits this graphic chart which he has designed and which he has found helpful to his own work.

The flow of steam through pipes has been investigated and various formulas advanced by these investigators. However, all these formulas are based upon Bernoulli's theorem for the flow of liquids in pipes; and in general they differ only in the constants which are used to modify the formula that governs the flow of liquids in pipes and renders it applicable to the flow of steam. Of these formulas for the flow of steam, the one given by Babcock is probably the one most generally accepted, and it is the formula used in constructing the chart shown on page 262.

Babcock's formula is as follows:

$$W = 87\sqrt{\frac{pDd^5}{\left(1+\frac{3.6}{d}\right)L}}$$

Where W = the weight of steam passing in pounds per minute; p = the difference in pressure between the two ends of pipe in pounds per square inch absolute; D = the density of steam in pounds per cubic foot; d = internal diameter of pipe in inches; L = the length of pipe in feet. For the derivation of this formula and authority for the constants employed, the reader is referred to any standard mechanical handbook. The following description will consider only the method employed by the writer in plotting this chart from the above formula and the method to be employed by the reader when using the chart for the purpose of solving steam piping problems.

The chart is plotted to a logarithmic scale, and the multiplications and divisions required in the solution of formula are effected by the addition and subtraction of two lengths which correspond to the logarithms of the quantities involved.

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In the formula:

$$W = 87\sqrt{\frac{pDd^5}{\left(1+\frac{3.6}{d}\right)L}}$$

L is taken as 100 feet in plotting chart; substituting this value, $W = C_0\sqrt{\frac{pDd^5}{1+\frac{3.6}{d}}}$ where $C_0 = 8.7$.

Also, for any given size of pipe,

$W = C\sqrt{pDd^5}$ where C depends upon value of d;

and $\frac{W^2}{C^2} = pDd^6$

or $\frac{W^2}{C^2}\cdot\frac{1}{D} = p\cdot d^6$.

The above form is the one which has been used for plotting the chart, and it is obvious that this formula can be used with only that size of pipe or value of d which was previously substituted to obtain C; a different value of C being required for each different pipe size employed.

The multiplication and division of the quantities in formula are effected graphically as follows:

Referring to Fig. 1.

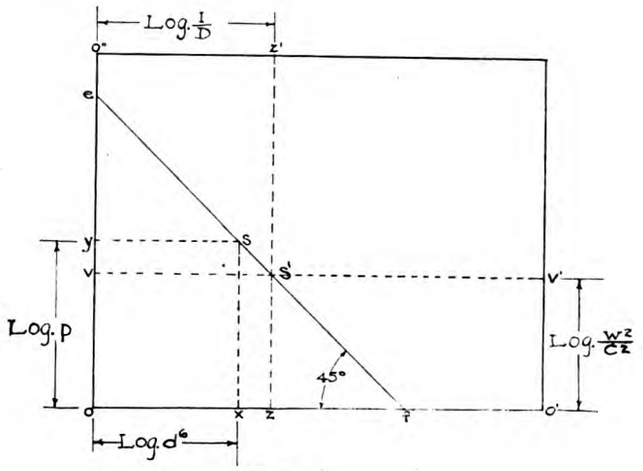

Fig. 1

The distance $oy = log\ p$ and distance $ox = log\ d^6$. These two coördinates determine the point s. Then draw line ef through s so that angle $efo = 45°$.

In the triangle sxf, $sx = xf = log\ p$,

Then $of = ox + xf = log\ d^6 + log\ p$.

Therefore ef may be used as a reference line and

$$of = log\ P + log\ d^6 = log\frac{W^2}{C^2} + log\frac{1}{D}.$$

Also $log\frac{W^2}{C^2} + log\frac{1}{D}$ is plotted to reference line ef as follows:

$$ov = o'v' = log\frac{W^2}{C^2} \text{ and } oz = o''z' = log\frac{1}{D}.$$

These two latter values are projected to the right and to the top of figure respectively for the sake of clarity, and also because the quantities are plotted in this man-

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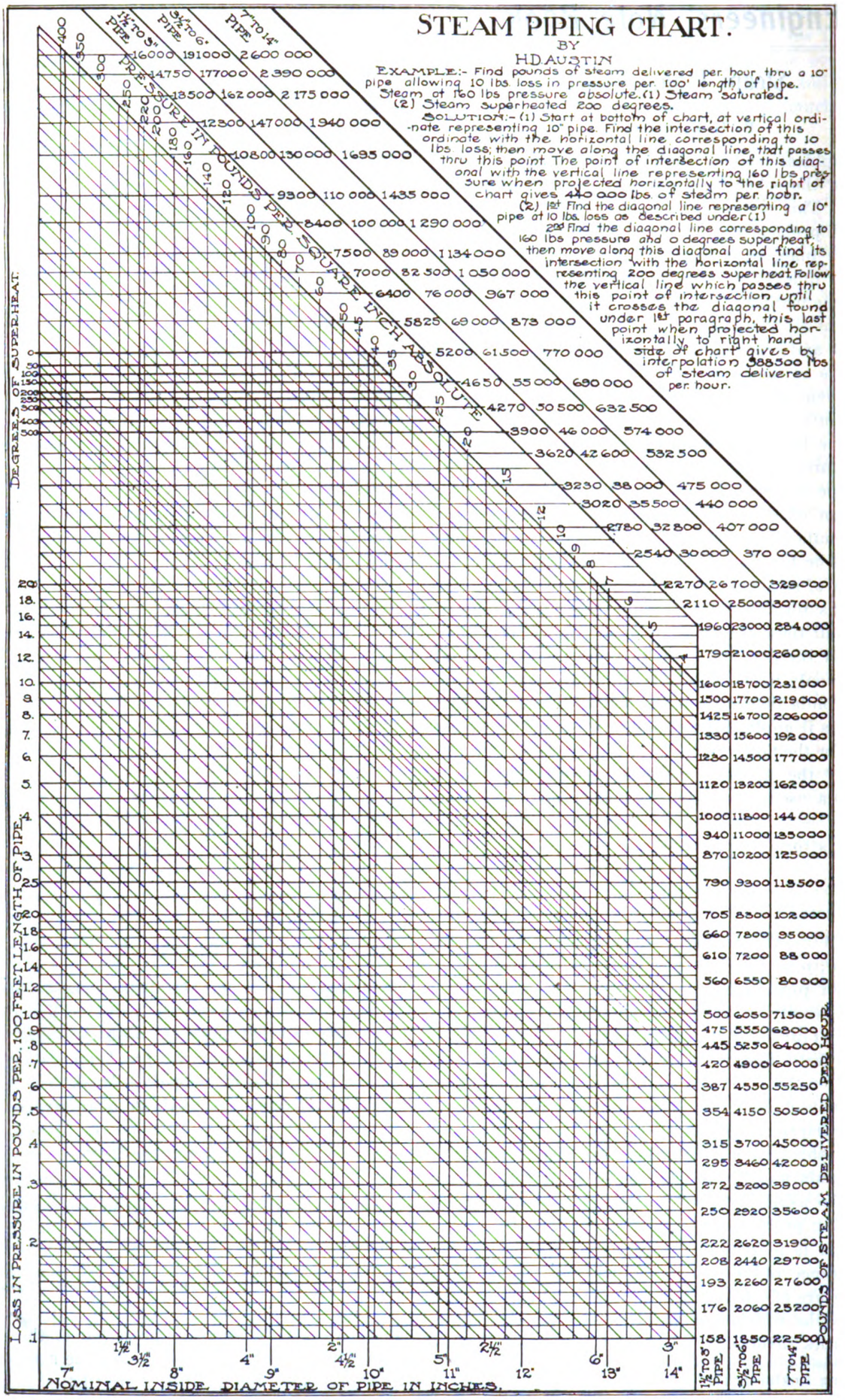
STEAM PIPING CHART.
BY
H.D. AUSTIN
EXAMPLE:- Find pounds of steam delivered per hour, thru a 10" pipe allowing 10 lbs. loss in pressure per 100' length of pipe. Steam at 160 lbs pressure absolute. (1) Steam saturated. (2) Steam superheated 200 degrees.
SOLUTION:- (1) Start at bottom of chart, at vertical ordinate representing 10" pipe. Find the intersection of this ordinate with the horizontal line corresponding to 10 lbs. loss; then move along the diagonal line that passes thru this point. The point of intersection of this diagonal with the vertical line representing 160 lbs pressure when projected horizontally to the right of chart gives 440 000 lbs. of steam per hour.
(2) 1st Find the diagonal line representing a 10" pipe at 10 lbs. loss as described under (1)
2nd Find the diagonal line corresponding to 160 lbs pressure and 0 degrees superheat, then move along this diagonal and find its intersection with the horizontal line representing 200 degrees superheat. Follow the vertical line which passes thru this point of intersection until it crosses the diagonal found under 1st paragraph, this last point when projected horizontally to right hand side of chart gives by interpolation 388500 lbs of steam delivered per hour.
1½" TO 3" PIPE
3½" TO 6" PIPE
7" TO 14" PIPE
PRESSURE IN POUNDS PER SQUARE INCH ABSOLUTE
DEGREES OF SUPERHEAT
LOSS IN PRESSURE IN POUNDS PER 100 FEET LENGTH OF PIPE.
NOMINAL INSIDE DIAMETER OF PIPE IN INCHES.
POUNDS OF STEAM DELIVERED PER HOUR.
1½" TO 3" PIPE
3½" TO 6" PIPE
7" TO 14" PIPE

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ner in the large chart. It is, therefore, obvious that the point s' determined by coördinates ov and oz falls upon line ef. Therefore, having given any three of the quantities contained in the equation

$$\frac{W^2}{C^2} \cdot \frac{1}{D} = p \cdot d^6$$

the fourth can be found graphically as follows:

Assume the quantities D, p, and d as known, substituting their values in the above equation and referring to Fig. 1:

First we find $oy = log\ p$ and $ox = log\ d^6$. These coördinates determine the point s, and then we move along the life ef until we arrive at a point s' which has for its abscissa $oz = log \frac{1}{D}$; then projecting point s' to the scale of ordinates, the length $ov = log \frac{W^2}{C^2}$ and the value of W is thus determined.

In plotting the large chart a logarithmic scale is employed. At the left-hand side of the chart will be found the scale of ordinates corresponding to value p, this value being plotted to represent the 'Loss in pressure in pounds per 100 feet length of pipe.' At the bottom of the chart is the scale of abscissae which corresponds to the value of d^6. This value is found and plotted as representing the 'Nominal inside diameter of pipe in inches.' It will be noted that this scale of pipe diameters covers three times the length of chart. This method of design is possible with a logarithmic scale; but necessitates the use of three columns of ordinates at right and top of chart corresponding to the value $\frac{W^2}{C^2}$, which value is reduced and plotted as 'The pounds of steam delivered per hour.' By using three columns of ordinates at right of chart, the size of chart is greatly diminished in size without in any way reducing its accuracy or usefulness.

In using the chart for solving steam piping problems, it will only be necesary to choose the column of 'Pounds of steam delivered' corresponding to the pipe size adopted. To facilitate correct usage in this respect, the correct pipe sizes corresponding to each column of 'Pounds of steam delivered' is noted at both top and bottom of each column.

At top of chart will be found the scale of abscissae representing the value of $\frac{1}{D}$. This value has been reduced and plotted as 'The pressure in pounds per square inch absolute.' This value $\frac{1}{D} = V =$ the specific volume of steam in cubic feet per pound, and it depends upon both the pressure and the degree of superheat. As previously described, the chart will solve problems only for saturated steam. To obtain the correct value of V for solving problems involving superheated steam, the horizontal superheat lines on chart are plotted. These lines actually represent the ratio of $\frac{V_0 \text{ (saturated)}}{V_s \text{ (superheated)}} = R$, and by means of this ratio R the value of V_s is found by dividing graphically V_0 by R.

The use of chart for solving problems in both saturated and superheated steam is illustrated by means of the problem printed upon the right-hand upper corner of chart. From the previous description and the illustrative problem given, it will be noted that since in formula

$$\frac{W^2}{C^2} \cdot \frac{1}{D} = p \cdot d^6$$

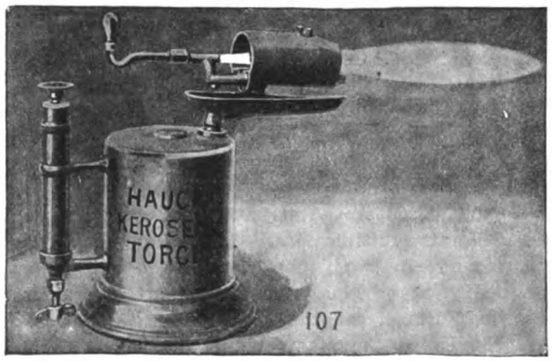
the value of C decreases as d increases and has a different value for each size of pipe used. Therefore, the chart solution will deviate slightly from a solution by means of Babcock's formula. However, between the values of C for a given size of pipe and C_1 for the next larger size, $C > C_1$, but only by a small amount. Therefore, in designing the chart, the values of $W =$ 'Pounds of steam delivered per hour' as shown in columns, are obtained by causing the value of C to vary uniformly from C to C_1; thus in column noted 1½ to 3-in. pipe, the values of C vary from 3.812 for a 1½-in. to the value of 3.369 for a 3-in. pipe. Therefore, the small error which is introduced is negligible and also on the side of safety, as the result is in general slightly less than that obtained by formula.

Further, owing to the variation in friction along the inner surface of pipe, also friction of bends, elbows, valves, etc., which can only be calculated approximately, the chart solution may be considered as accurate as the formula for all practical purposes.

Industrial Progress

THE HAUCK KEROSENE TORCH

A kerosene torch of new and novel design has just been placed on the market by the Hauck Mfg. Co., of Brooklyn, New York, which is distributed by the Pacific Coast branch, The



THE HAUCK KEROSENE TORCH.

Hauck Mfg. Co., 24 California street, San Francisco, California. It was especially designed to take the place of the gasoline torch. The most important feature is the construction of

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the bronze burner. The oil passageways are especially large, and so arranged that only one plug has to be unscrewed in order to clean the whole burner instantly.

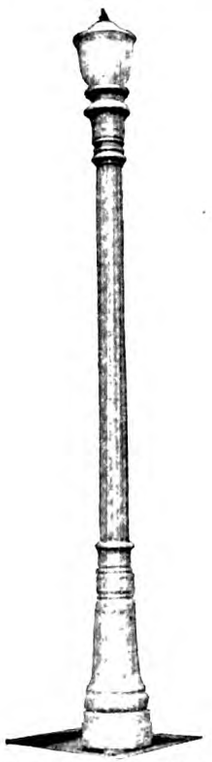
By a special oil-regulating valve, the flame can be adjusted to any size from 8 in. long by 1 in. diameter to the finest point. As kerosene contains more heat units than gasoline, the temperature obtained with this torch is much higher than that by the gasoline torch, which makes it especially suitable for brazing and soldering heavy cables, armature repair work, burning off insulation, as well as for general shop repair work.

It is especially recommended for outside work. The torch is also furnished in connection with a light furnace for melting solder and heating soldering coppers.

NEW UNITS FOR ORNAMENTAL STREET LIGHTING WITH HIGH CANDLE-POWER MAZDA LAMPS

An attractive line of fixtures, designed for operation of the new sizes of Mazda series lamps for 'White Way' or ornamental street lighting, is now being made by the General Electric Company.

These new fixtures are termed Novalux ornamental units,



GENERAL ELECTRIC 'NOVALUX' ORNAMENTAL UNIT.

are made for both series and multiple operation, and will accommodate the 400 and 600-cp. 6.6-amp., and the 600 and 1000-cp. 20-amp. sizes of the series Mazda, and the 400, 500, 750, and 1000-watt multiple Mazda lamps.

They are made in two general styles, the only difference, however, being in the glassware equipment. The glassware on one style, Form 4, consists of a medium alabaster globe, which is so shaped that it is completely filled with light and permits a certain amount of light to pass upward and illuminate the building fronts. There is a small reflector placed at the top and inside of the globe. The function of this reflector is to direct downward and make useful the light that would otherwise be lost in the bottom of the ventilator surmounting the globe.

The other style of unit, Form 5, has a two-piece globe. The bottom part is made of 'C. R. I.,' that is, crystal rough inside glass, while the top is made of Pyro glass. No reflector is used, as the Pyro top is made of dense glass having the inside glazed, thereby reflecting downward some of the light, although enough filters through to illuminate properly the building fronts.

These new units are highly ornamental, and the casings, which are designed to form the capital of the pole, are made in four different styles, from which a selection can be made to harmonize with the pole design.

As ventilation is a very important feature in fixtures designed for the new sizes of Mazda lamps, this matter has been given very careful attention. Air enters through small holes in the globe seat, and leaves, in the case of the Form 4 unit, through concealed openings in the spun copper ventilator at the top of the globe; and, in case of the Form 5 lamp, it leaves through the space provided between the top and bottom globe. The socket used in these fixtures is made in skeleton form, which permits a circulation of air to all parts.

As the efficiency of the 20-amp. Mazda series lamps is much higher than that of the 6.6-amp. lamps, the Novalux ornamental series unit contains an internal individual compensator mounted inside of the ornamental casing.

These compensators operate the 20-amp. lamps on 6.6 or 7.5-amp. circuits. This saves about 30% of the energy required to operate the lamps and permits them to be connected in standard existing circuits, thereby allowing the extension of the lighting system without additional station equipment.

The compensator also reduces the effect of destructive current surges that may be set up by arcing or permanent grounds. Two different sizes of compensators are made for use respectively with the 600 and 1000-cp. 20-amp. series Mazda lamps, and are equipped with taps for operation on either 6.6 or 7.5-amp. series alternating constant current circuits. The series unit is mounted on a strain insulator whose function is to keep high voltage from the poles.

The multiple Novalux ornamental units are similar to the series, except that the strain insulator is replaced by a cast iron adapter of similar dimensions and no compensators are used.

THE MORAN CONCRETE MIXER

Discarding the policy of most manufacturers of small concrete mixers to design their machine so it may be sold for a cheap price, the Moran Engineering Co., of Seattle, Washington, has put on the market one that combines with careful design the highest class of workmanship and material, and the result is something new in the mixer line that will put added profits in the pockets of the wide-awake contractor.

The machine is of the two-wheel, end charge and discharge type, and is operated by a large throttling-governed gasoline engine mounted on the framework above the drum, and drives the drum through two sets of pinions and gears. The drum head, gear, and track are all one tough gray iron casting. The track is machined and the gear is cast with a shroud adding materially to the strength of the teeth. Around both the charge and discharge openings a deep lip has been cast on the inside to prevent slopping when wet material is being mixed. The drum is supported on carefully machined cast iron trunnion rollers that are keyed to shafts that run in large babbitted bearings. The entire weight of the machine is so balanced over the axle that one man can pick it up and the usual gang around a job can move it anywhere. All bearings are provided with pressed steel compression grease cups, and all nuts are held in place with tempered steel lock washers. The regular equipment includes a magneto, a hose connection, a two-point quick adjusting friction clutch on the

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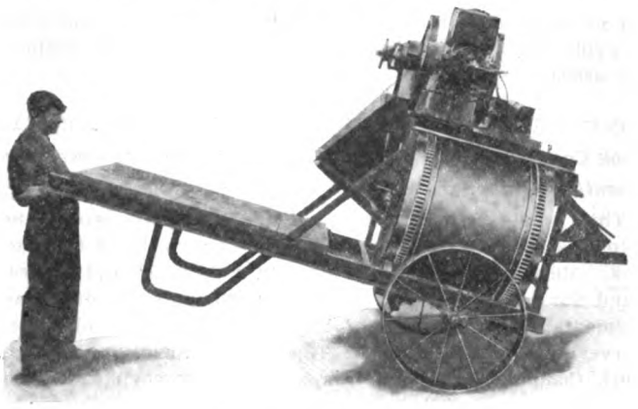
engine, and a pressed steel housing with lock, to cover the engine when not in use.

In selecting this type of mixer the Moran Engineering Co. believed that the point had been reached in the development of the concrete business that demanded that a small mixer of medium cost, but with large capacity, should be furnished to the large contractor for his small work, and to the small contractor for the general run of work that he gets. The arrangement of the machine is such that it can be operated to advantage with as few as two men, while if more men are added the capacity can be increased proportionately. The large wheels and light weight make it as easy to move to and from the job as wheelbarrows. The careful selection of material and the thorough manner in which the machine is built insures freedom from break-down and consequent loss of time. The over-all width from outside to outside of the wheel tires is only 48 in., so it can be placed between the strips when laying sidewalks. The actual capacity is best evidenced by the facts that one of the machines working on sidewalk laid 403 yards of sidewalk base one day and 997 lin. ft. of curb the next with a gang of seven men working eight hours, while a second machine put 43 cu. yd. into the forms for a building at Renton, Washington, in the same number of hours.



MORAN CONCRETE MIXER.

Hints on Practice

OLD BOXES FOR CONCRETE FORMS

The accompanying drawing shows two boxes, one smaller than the other. The wooden strips nailed across the top of the inside or smaller box keep it suspended a few inches above the bottom of the larger box. These two boxes may be used as forms. The smaller box is suspended in the manner described in order that it may not sink into the fresh concrete when the bottom layer is put into the larger box. After this first or bottom layer of concrete is placed, the space between the sides and ends of the two boxes is filled with concrete and the result will be a box of concrete of the dimensions represented by this space. If great strength is required, wire or small steel rods may be imbedded in the concrete as it is built up. If a porous concrete is required, it may be made of cinders with the quantity of cement and sand somewhat reduced.

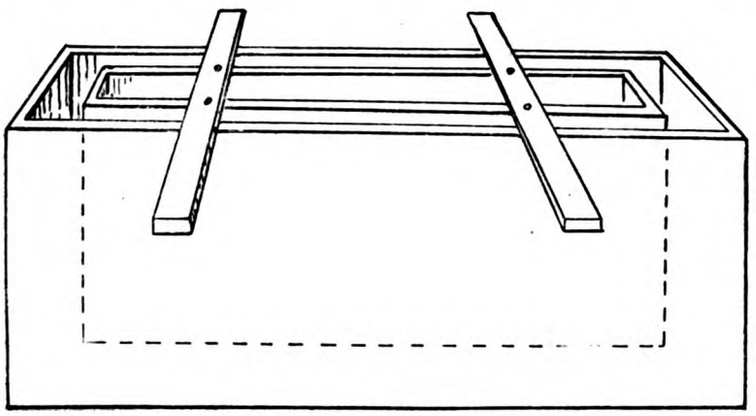
By the use of a dense and impervious concrete, reinforced as described above, but especially at the corners, the forms will answer for a small tank or watering trough. Where tanks are to be placed in exposed situations subject to freezing, it would be well to slope the inside form by making it a little smaller at the bottom than at the top, thus providing an inclined interior surface upon which the ice will tend to slide upward, thereby preventing the destruction of the tank.

With pipe openings established, these box forms are available for the construction of a kitchen sink or slop drain, as well as a drain for an outside pump or faucet.

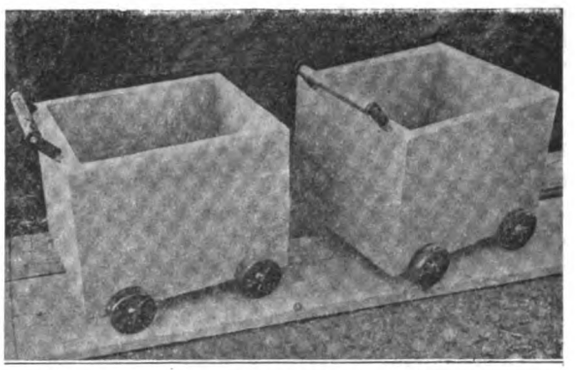
Such receptacles would make excellent refuse boxes, and if large would be convenient for storage purposes.

In using old boxes in the manner described, it must be understood that the chief object in view is to do the work as cheaply as possible. In most cases, unless the boxes are perfectly smooth and oiled or soaped before the concrete is put in, it will be necessary to destroy them in removing them from the concrete.

Or if the builder cares to use well made forms provided with hinges and locking devices to facilitate their removal and repeated use, they can be used over and over again.



THIS DRAWING SHOWS HOW THE STORE BOXES SHOULD BE ASSEMBLED AFTER A LAYER OF CONCRETE IS PLACED IN LARGER BOX.



SMALL BOXES MADE OF CONCRETE.

(The maker of the boxes shown has enlarged upon the original idea by adding wheels and handles, thus making them portable. These are feed boxes.)

A satisfactory mixture for work of this kind is 1 part portland cement, 2 parts sand, and 4 parts stone or gravel. When placed in the forms it should be thoroughly tamped and worked from side to side with a flat paddle.

IT IS STATED that there is a market in South America and the West Indies which could absorb anywhere from 12,000,000 to 15,000,000 bbl. of American cement, or enough to liquidate the entire overproductive capacity of the Lehigh Valley district, and even create an actual shortage in other sections where cement is made.

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Book Reviews

STEAM CHARTS. By F. O. Ellenwood. P. 86. Index. John Wiley & Sons, New York. For sale by *Mining and Scientific Press*, San Francisco, Price, $1.

This work includes heat volume and external work volume charts for wet and superheated steam, together with tables of various corrections. The fundamental principles governing the use of steam tables and charts are discussed, and the remainder of the book is devoted to the solution of a number of practical problems by means of the charts given.

FUEL: GASEOUS, LIQUID, AND SOLID. By J. H. Coste and E. R. Andrews. P. 271. Index. J. B. Lippincott Company, Philadelphia. For sale by *Mining and Scientific Press*, San Francisco. Price, $2.

As the title would indicate, this work may more properly be classified as a handbook of general reference than a comprehensive treatise on every detail of the subject. The information presented has been carefully prepared and is free from extended discussion, the authors' idea apparently having been to prepare a book of reference in compact form to supplement the larger works already available.

THE MECHANICAL PROPERTIES OF WOOD. By Samuel J. Record. P. 160. Index. John Wiley & Sons, New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $1.75.

So much attention has been devoted in the technical press lately to other structural material that we are prone to lose sight of the fact that wood and a knowledge of its characteristics will always be an essential part of engineering and engineering construction. This book has been prepared primarily for students of forestry. No reference is made to higher mathematics; the subject matter having been prepared in its simplest form in order to make it available to everyone interested in wood. The subject is subdivided into chapters on the mechanical properties of wood, factors affecting the mechanical properties, methods of timber testing and an appendix covering the working plan adopted by the U. S. Forest Service.

STRUCTURAL ENGINEERS' HANDBOOK. By Milo S. Ketchum. P. 882. Index. McGraw-Hill Book Co., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $5.

This is probably the most complete and concise treatise on structural steel design in existence. In Part I the different types of steel structures, including Mill Buildings, Office Buildings, Highway Bridges, Railway Bridges, Bins, Grain Elevators, Coal Tipples, Standpipes, and Tanks, are discussed in detail, together with Retaining Walls, Abutments, and Timber Bridges. Then follow chapters on Structural Drafting and Design, Estimation and Erection of Steel, Engineering Materials, and Structural Mechanics. Part II contains an unusually complete set of tables of the dimensions and other properties of practically every standard steel product, both singly and in combination, together with several other common mathematical tables.

STEEL CONSTRUCTION. By Henry Jackson Burt. American Technical Society, Chicago. P. 372. Index. For sale by *Mining and Scientific Press*, San Francisco. Price, $2.75.

The scope of this work is indicated better by the sub-title, 'A Text and Reference Book Covering the Design of Steel Framework for Buildings,' as building construction only is discussed. The author first considers the method of manufacture and properties of steel sections, together with specifications therefor. The chapters following consider Rivets and Bolts, Beams, Riveted Girders, Columns, Tension Members, and Wind Bracing, and Protection from Rust and Fire. There is also a complete discussion, including calculations and plans, of a sixteen-story Class A hotel erected in Chicago. A number of the usual tables are included in the text, but the book is evidently not intended to be used in designing without the assistance of one of the trade pocket-books.

PLANE SURVEYING. By William G. Raymond. American Book Co., New York. P. 579. Index. For sale by *Mining and Scientific Press*, San Francisco. Price, $3.

This is the second edition of Mr. Raymond's work, and is published in pocket form. The author considers by chapters: Measurement of Horizontal Lines, Altitude, and Angles; Land Survey Computations; Office Instruments; Stadia Measurements; Determination of Meridian, Latitude, and Time; Surveying Methods; Curves; Topographic Surveying; Earthwork Computations; Hydrographic Mine Surveying. Of the appendices which follow, those on 'The Judicial Functions of Surveyors' and 'United States Public Land Surveys' are the most valuable. While the work is primarily a text-book for students, it contains much that may be read with profit by the practising surveyor. It is unfortunate that, in revising the book for this edition, the statement on page 276, to the effect that public land surveys are still being made by contract was not corrected. The usual mathematical tables are included in the book.

Recent Publications

CATERPILLAR TIMES, August 1914. The Holt Mfg. Co., Stockton, California.

N. F. A. SAFETY BULLETIN, June 1, 1914. National Founders Association.

THROUGH ROUTES FOR CHICAGO'S STEAM RAILROADS. The City Club, Chicago, Illinois.

UNIVERSAL BULLETIN, August 1914. The Universal Portland Cement Co., Chicago, Illinois.

FLUMES AND FLUMING, by Eugene S. Bruce. Bulletin No. 87, U. S. Department of Agriculture.

FOURTH ANNUAL REPORT OF THE BOARD, Department of Public Utilities, Los Angeles, California.

ON A TABULATION OF REDUCED BINARY QUADRATIC FORMS OF A NEGATIVE DETERMINANT, by Harry N. Wright. The Abelian Equations of the Tenth Degree Irreducible in a Given Domain of Rationality, by Charles G. P. Kuschke. University of California, Berkeley, California.

IS THE EFFICIENCY OF A THERMODYNAMIC REVERSIBLE CYCLE INDEPENDENT OF THE WORKING MEDIUM? By Jacob T. Wainwright. Pamphlet. P. 8. An addendum to papers entitled 'An Investigation of the Second Law of Thermodynamics'; and 'The New Thermodynamics.'

DEFEATING RUST—THE STORY OF ARMCO IRON, IRON ROOFS THAT RESIST RUST and A JOURNEY TO ARMCO FARM are the titles of three new publications on 'Armco' products recently issued by the American Rolling Mill Co. of Middletown, Ohio. In the booklet on the story of 'Armco' iron are shown many illustrations of 'Armco' iron used for roofs, ventilators, gutters, lath, window frames, stoves, refrigerators, culverts, pipes, etc. The booklet entitled 'Iron Roofs that Resist Rust' contains an article on why iron roofs resist rust and illustrations and descriptions of many forms of 'Armco' iron used in roof construction. Rules for estimating amount of corrugated iron required to cover given spaces, tables of weights, and list of products manufactured of 'Armco' iron are also given in the booklet. 'A Journey to Armco Farm' contains an interesting story of the various uses to which 'Armco' iron is put.

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Construction News Summary

Condensed From Our Daily Construction News Service.

ARIZONA

PHOENIX—Plans are being considered for municipal electric lighting plant. Cost $60,000.——Bids will be received at office of U. S. Reclamation Service, until 2 p.m., December 5, for structures on Arizona canal on Salt River project. Work near Phoenix; includes 490 cu. yd. plain and reinforced concrete; erection of two bridges, includes 19,000 ft. B. M. lumber, and 1200 cu yd. earthwork. Plans and specifications from U. S. Reclamation Service, Phoenix, Arizona, or Washington, D. C., or may be inspected at this office.

TUCSON—Following bond issues will be voted on, December 14: $14,000 for erection of armory, $20,000 for fire department, $45,000 for reinforced concrete bridge, $50,000 for outfall sewer system, and $50,000 for city hall.

CALIFORNIA

ALHAMBRA—H. F. Roberts was awarded contract for primary school building on Garfield avenue; cost $7684. Plumbing and heating was awarded to Cooney & Winterbottom at $1246. ——Contract for construction of Garvey Avenue school was awarded to H. F. Roberts at $22,855 50. E. O. Nay Co., Pasadena, has contract for heating at $3202; Cooney & Winterbottom for plumbing at $2165.

AZUSA—Bonds for $55,000 for light and water plants have been voted.

BELDEN—Plumas County supervisors are considering wagon road from Belden to Longville.

BRAWLEY—Bonds for $35,000 have been issued for extension of water system. C. J. Park, city engineer.

BAKERSFIELD—County Highway Commission has received bids for constructing 9½ miles of transmission line, as follows: Power Equipment Co., Rialto building, San Francisco, $11,000; and J. R. Cahill, $16,000.——The Oak Creek irrigation project is planning to irrigate 20 sections of land northwest of Mojave and 8 miles southeast of Tehachapi. The plan is to build a 160-acre reservoir. James Arp, of Bakersfield, is interested; Kingsbury Sanborn is engineer; and T. F. Gibbon, manager of the Bankers' Bonding Co. of Los Angeles, is going to handle the proposed bond issue.——The Southern California Edison Co., of Los Angeles, is planning to divert 600 sec.-ft. of Kern river for power purposes, taking water from point on the northeast quarter of section 12, 23-32, conduct it 13 miles through a concrete flume, and use it in a power-house. The water will have a head of 780 ft. and will develop 30,000 kw. Estimated cost of project, $5,000,000.——County Supervisors have awarded contract to F. H. Jameson, of Woody, to grade and build bridges and culverts on county highway in district 9, section 2; bid, $9485.14.

CASTELLA—Trinity Asbestos Mining Co. will build road 20 miles long, costing $45,000.

CHICO—Sub-contract for grading and cement work on Esplanade was awarded to Chico Construction Company.

CHINO—Plans are being prepared by Olmsted & Gillelen, Wright & Callender building, Los Angeles, for proposed sewer system.

COLTON—Allison & Allison, 1405 Hibernian building, Los Angeles, will prepare plans for grammar school building, costing $80,000.

COMPTON—Plans are being prepared by P. V. Tuttle and A. W. Angel, 619 Delta building, Los Angeles, for commercial and home economics buildings for Compton high school. Cost about $40,000.

CORNING—Trustees will call election on $30,000 bond issue for extending water and sewer system.

CORONA—Santa Fe Railroad will build five-mile spur to nearby packing-house. Cost about $100,000.

DECOTO—Contract for construction of dormitories for California Masonic Home has been awarded to Thomas H. Day's Sons, Wells Fargo building, San Francisco. Cost $34,787.

DIXON—Plans have been prepared for union high school building costing $53,000.

EAGLE ROCK (Glendale post-office)—H. A. Reeves, Chamber of Commerce building, Los Angeles, is preparing plans for construction of fireproof school. Cost $60,000.

EAST SAN DIEGO—City Engineer H. A. Kuehmsted is preparing plans for 30 miles of sewers. Work will be commenced about middle of 1915.

EASTON—Surveys are being made for extension of Easton electric railroad.

ESCONDIDO—Bonds for $100,000 for water system have been sold, and work will be commenced soon. Water will be obtained from bored wells in Escondido river bottom, and there will be a pipe-line about one mile long to a reservoir on Park hill and a distribution system.

EXETER—Board of Directors for Carnegie library has accepted the plans submitted by architects Bowen & Davis of Fresno. The library will cost $5000.

ELDRIDGE—Louis Cereghino & Son, San Francisco, were awarded contract for construction of cottage at Sonoma State Home. Cost $15,475.

EL CENTRO—The Imperial Valley irrigation district has voted a bond issue of $3,500,000 for the purchase of the California Development Co. irrigation system.

FAIRFIELD—Board of Supervisors of Solano county has authorized purchase of $100,000 of state highway bonds.

FOWLER—The Fowler Gas Co. plans to make extensive additions to its plant in this city with the $15,000 bond issue authorized at a recent hearing of the State Railroad Commission.

FILLMORE—Following bids were received for construction of reinforced concrete jail: Empire Construction Co., 517 Union Oil Bdg., $955; Ed. Alplanalp, Oxnard, $1038; R. Smith, $1150; Kreiter Bros., $1160; Partee & Yerkle, $1250; Stephenson & La Rue, $1490.

FRESNO—Bowers Rubber Co. has been awarded contract for furnishing 8250 ft. of fire hose.——City has asked for bids for concrete bridge across Dry creek at Van Ness avenue. Cost $5000 ——Fresno Interurban Railway Co. has applied to the Railroad Commission for authority to issue $212,500 common stock and $350,000 bonds. Proceeds will be used to build 26 miles of road near Fresno. J. B. Rogers, president. Work on construction of the Fresno Interurban line, to extend from Fresno avenue by way of the Normal School to Gould Colony, will commence in a few days. Line will be about two miles long.——Berry Estate will erect a $75,000, four-story, brick and steel hotel building on site of Fulton hotel. R. F. Flechin is architect ——Contract for Princeton school awarded to S. L. Allen. Price $1369.——Plans completed for the F. M. Roessler building. Cost $70,000. Swartz, Hotchkin & Swartz are architects.——V. Jarmagian will erect two-story brick building on I street. Cost $20,000. Bowen & Davis, architects.——Fresno Canal & Irrigation Co. is planning canal work and other improvements to its system.——Valley Ice Co. will double capacity of plant, including installation of 400-hp. motor.

GLENDALE—Contracts for reinforced concrete bridge over wash at Opechee way, and for grading and protecting the channel, have been awarded to Mesmer & Rice, Marsh Strong Bdg., Los Angeles, at $10,000 and $8238 respectively.——Two-story brick building will be erected. Arthur G. Lindley, 412 Hollingsworth Bdg., Los Angeles, architect.

GLENDORA—Board of Trustees will receive bids until 8 p.m., December 7, for improvement of Meda avenue; approximate quantities, 1270 ft. curb, 5600 sq. ft. gutter, 6900 sq. ft. walk, 46,000 sq. ft. macadam, one concrete culvert. Plans from city clerk, or from F. G. Dessery, city engineer, 511 Central building, Los Angeles, California.

GILROY—City Engineer H. B. Fisher has reported to City Council concerning route survey for pipe-line near reservoir. Water committee will advertise soon for bids for its construction ——Surveys are being made for reclamation district south of here. Miller & Lux, Merchants Exchange Bdg., San Francisco, are interested.

GRASS VALLEY—Nevada County Water Consumers' Association will form an irrigation district under the law of 1913 for the purpose of voting bonds for the construction of a system of water distribution for farm lands below this city. Estimated cost, $345,000. A. L. Wisker is president and F. H. Bolster is secretary.

HOLTVILLE—Plans for erection of jail are being considered. D. A. Starbuck, city engineer.

HANFORD—Road Commissioners have decided to postpone action in voting bonds for good roads until condition of bond market is improved.

KINGSBURG—Johnson Bros. have been awarded contract for curbing and sidewalks.

LINDSAY—It is proposed to impound 30,000 to 40,000 acre-feet of water in the Yokohl valley, by a dam approximately 150 ft wide. Preliminary surveys have been made by Raymond J. Wyseur and R. D. Adams.——Bonds for $50,000 for schoolhouse have been sold.

LOST HILLS—Kern Valley Reclamation Co. will build canal from section 21, T. 28 S., R. 22 E., northward to Tulare lake Miller & Lux, Merchants Exchange Bdg., San Francisco, are principal stockholders.

LONG BEACH—J. L. Frazer was awarded contract at $1054.35 for grading Bermuda street.——Contract for Belmont Heights pier has been awarded to Trounce & Stoecher, of Los Angeles, at $46,000.

LORDSBURG—Contract has been awarded to Somers Lund Co., Los Angeles, for erecting reinforced concrete pre-cooling plant for La Verne Orange Growers' Association. Cost $75,000.

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LODI—Chamber of Commerce is interested in movement to obtain appropriation of $15,000 from state to build six miles of road between Clements and Mokelumne river.

LOS GATOS—Bonds for $6000 for purchase of chemical fire apparatus will be issued.

LOS ANGELES—Tryon & Brain, Merchants Trust Bdg., were awarded contract for improving Vermont avenue between 58th street and Manchester avenue at $116,436.34. Other bidders were: George H. Oswald, $122,675.21; Ford & Stout, $127,282.93; Fairchild-Gilmore-Wilton Co., $128,187.65. Tryon & Brain were also awarded contract at $54,124.13 for improving Western avenue between Wilshire boulevard and Temple street. Other bidders were Fairchild-Gilmore-Wilton Co., $56,720.23; Ford & Stout, $58,448.61.——Fred Hoffman, 11 East Twelfth street, Long Beach, was awarded contract at $10,580.90 for improving Painter avenue south from Whittier city limits.——Fairchild-Gilmore-Wilton Co. was awarded contract at $46,083.22 for improving East Seventh street.——Marine Hardware Co. awarded contract for furnishing supplies, spikes, and bolts for municipal dock. Price $1200.——Plans have been prepared for six-story reinforced concrete warehouse on Huntington fill to be built by city. Cost $286,000 ——O. H. Mennet will erect a two-story brick building. Frank L. Stiff, 721 Grosse building, architect.——J. M. Williams will erect a two-story brick building. Elmore R. Jeffery, 605 Wesley Roberts building, architect.——Williams Simpson Construction Co., San Diego, was awarded contract for erection of freight shed for Santa Fe Railway Co. in Los Angeles.——City Engineer is instructed to prepare plans and estimates for proposed open-cut through Bunker Hill from Hill street to Figueroa street, and from 140 ft. north of First street to 140 ft. south of Second street.——Fairchild-Gilmore-Wilton Co. was awarded contract for paving Hoover street. Cost $23,019.73.——W. F. Hewitt & Co. was awarded contract for grading on Nob Hill cut. Cost $77,000.——Board of Public Works has awarded contract for $56,879.73 to George R. Curtis for paving Santa Barbara avenue, from Budlong avenue to the western city boundary.——Harbor Engineer S. A. Jubb has submitted plans for proposed warehouse 152 by 480 ft., to be erected on municipal wharf.——Contract for the first two miles of the Western Avenue boulevard running southward from Manchester avenue was re-let to the Brashear-Burns company. ——P. J. Shea, 1800 Oxford street, was awarded contract for improving Alameda street, between North Main and 6th streets. Cost $195,147.31. Brashear-Burns company, Van Nuys building, low bidder at $10,310 for macadam paving in road district No. 71; and for grading and oil macadam paving and culverts in road district No. 74, at $10,860.——Fairchild-Gilmore-Wilton Co. has been awarded contract for improvement of Eighth street, from Center to Gaffey, for $27,695.27. George H. Curtis has been awarded contract for paving 22nd street from Gramercy place to Arlington avenue for $6696. Bids on following work were rejected, because too high, and work will be re-advertised. Fifth street from Pacific avenue to Meyler street; Third street from Occidental boulevard to Virgil street. Lowest bid on Fifth Street work was $50,699.92; and on Third Street work, $19,545.62. ——City Council has awarded contract to Los Angeles Manufacturing Co. for 9 new garbage wagons and to reconstruct 45 wagons.——Board of Public Works has awarded contract to Andrew Jayich for sewer in Fifth street near Van Ness avenue for $5200; contract to B. Sutalo for constructing sewer in 56th street for $3493.———Board of Public Service Commissioners has rejected latest offer of Union Hollywood Water Co. to sell its plant to the city for $750,000, and has instructed Chief Engineer William Mulholland to prepare an estimate of the cost of constructing a 16-in. main along Western avenue from Third street to Griffith park.——Robert T. Hale and Paul Yesser have made application for a city railway franchise from North Broadway and Pritchard street northerly to the South Pasadena city boundary.——Chief Engineer William Mulholland has appeared on behalf of the Public Service Commission before the Board of Public Works to request that the Board give authority to the Commission to proceed on its own initiative to construct tunnel through the San Francisquito canyon to provide a waterway for the aqueduct water. Public Service Commission will have about $6000 per month available for this work.——City Council adopted ordinance for installation of ornamental lighting system on Harvard boulevard, from 16th to Washington streets. This improvement is to cost an average of $3.50 per 50-ft. lot, the total cost being $1642.40, which includes expense of lighting for one year.——The J. W. Robinson Co. was granted a permit for structural work for its department store at Grand avenue, between Seventh and Hope streets. This work will cost $650,000. F. Noonan and W. Richards are architects and engineers. C. J. Kubach Co. has general contract for the work.——City will ask Railroad Commission to fix valuation of part of distribution system for Southern California Edison Co. for condemnation purposes. Llewellyn Iron Works has been awarded contract for furnishing doors and counter-weights for shed No. 1, municipal dock No. 1. Cost $6235. Naftzger & Howard have been awarded contract at $3043.64 for improving alley near Bonnie Brae street; they were also awarded contract at $2637.30 for improving Fourth street. A. Sikes has been awarded contract at $4380.46 for improving 51st street, and at $2754.33 for improving Venice avenue. C. W. Shafer has been awarded contract at $1315.87 for improving alleys near 24th street.——L. L. Jones, 1125 Central building, has prepared plans for three-story apartment house for W. W. Paden. Board of Supervisors will receive bids until 2 p.m., December 7, for improvement work in San Antonia protection district. Work consists of construction of pile dikes, involving 260 30-ft. cedar piles; furnishing and placing barbed wire on pile dikes, including 12,830 lb. barbed wire and 950 lb. staples; construction of earth levees, involving 6500 cu. yd.; planting of willows along lines of improvement work. A. M. McPherron, deputy clerk.——Fairchild-Gilmore-Wilton Co. has been awarded contract at $2436.50 for improving Third street.——F. O. Engstrum Co. has been awarded contract for erecting brick warehouse for Rudgear Merle Co.; cost $65,000.——Plans have been submitted by city engineer for conversion of incinerator on McPherson street to municipal asphalt plant; cost $8000.

MARYSVILLE—The Hallwood Irrigation Co. has unanimously voted to increase its capital stock from $25,000 to $50,000.

MANHATTAN BEACH—The California-Arizona Construction Co. has been awarded the contract for improving a number of streets. Cost approximately $200,000.

MARE ISLAND—Contract for construction of ward pavilion at Naval Hospital has been awarded to Gutleben Bros., New Call building, San Francisco, at $23,020.

MARTINEZ—Karl M. Neilson has been awarded contract for building three bridges on state highway between Pinole and San Pablo at $7807; other bidders were R. W. Mooler, $9571; Ralph L. Gorrill, $10,000; F. F. Moore, $10,004; Pacific Coast Construction Co., $10,781; M. M. Concannon Co., $11,140; G. H. Fields, $8824; Henry Layaz, $9982; J. C. Rogers, $14,173; Blake Bros., $11,200.——The Contra Costa County Gas Co. is planning gas lighting system at Pittsburg, Antioch, Concord, and Martinez ——The Mount Diablo Scenic Boulevard Co. will construct a toll road to top of Mount Diablo. Estimated cost $60,000. R. N. Burgess, 734 Market street, San Francisco, is interested. ——Delta Dredging Co. was awarded contract for dredging required on Martinez-Bay Point highway for $18,500. Contract for piling will not be advertised until after dredge work is completed.——Board of Supervisors has instructed County Clerk to bid in Richmond school bond issue of $75,000.

MENLO PARK—The Bear Gulch Water Co. has decided to make improvements in its plant costing $250,000.

MERCED—Thompson Brothers have been awarded contract for construction of three bridges. Total cost $4453.67. Following bids were opened for construction of barn for County Hospital: T. A. Wayne, $645.60; C. J. Droesch, $827; for remodeling Court House, installing heating system, Wilcock & Groom, $21,779; C. J. Droesch, $21,451.——Board of Supervisors will receive bids until 10 a.m., December 8, for construction of reinforced concrete bridge on state highway, road district No. 2. G. H. Whitworth, supervisor of road district No. 4, has been authorized to construct bridge on Netherton road across Los Garsos creek, and bridge on Cottonwood and Newman roads across irrigation canal.——Board of Supervisors will receive separate bids until 10 a.m., December 12, as follows: For installing heating system in court house; for installing heating system in county jail; for re-wiring court house; for plumbing in court house.——T. A. Wayne has been awarded contract for constructing barn for county hospital at $525.——All bids for remodeling court house have been rejected.

MODESTO—W. H. Worswick, Jr., was awarded contract for paving alley between J and K streets.——Modesto irrigation district is having plans prepared for steel siphon at Gasburg gulch crossing.——City Council has awarded contract to McGillivray Construction Co. for paving alleys between 10th and 11th streets for following unit prices: Grading, 1.8c. per sq. ft.; paving, 12.4c. per sq. ft.; redwood curbing, 12c. per lin. ft. For paving other alleys, contract was awarded to W. H. Worswick, Jr.: Grading, 1½c. per sq. ft.; paving, 13½c. per sq. ft.; redwood curbing, 16c. per lin. ft.——Supervisors will receive bids until 11 a.m., December 15, for construction of three bridges and one siphon. Plans and specifications on file with H. Benson, clerk of Board.

MORNINGSIDE—Austin & Pennel, Wright & Callender building, Los Angeles, are preparing plans for school building, costing $55,000.

MONROVIA—Bonds for $15,000 for street improvements were carried.

NEWPORT.—F. O. Engstrum Co., of Los Angeles, has been awarded contract to install 139 standard street lights at $14,968.

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OAKDALE—C. L. Palmer was awarded contract for grading and improving Burneyville road. Cost $700.

OAKLAND—Contract was awarded to Moore & Scott for repairs and new parts for municipal dredge. Bid $8550. Contract for 6900 ft. fire-hose was awarded to American Rubber Co. at 72c. per ft.——Doak Gas Engine Co., Fourth and Madison streets, has been awarded contract for furnishing two direct-connected internal-combustion engine-driven air-compressors at $3244, by U. S. Lighthouse Inspector.——Following bids have been received for furnishing and installing special lighting fixtures: H. S. Tittle, $24,700; Thomas Day Co, $27,500; Tiffany Studios, $31,700; Maxwell Hardware Co., $35,999; English Co., 39,262.——Second Church of Christ, Scientist, will erect $75,000 steel frame and brick building at 34th and Elm streets. W. A. Newman, Hewes building, San Francisco, is architect.——C. A. Bruce has been awarded contract for bridge across San Lorenzo creek on Hazel avenue. City Supervising Architect J. J. Donovan has completed plans of school to cost $165,000.

ONTARIO—Bids will be received until 5 p.m., December 14, for improving roadway of part of Euclid avenue. Work will consist of approximately 350,000 sq. ft. of grading and paving with concrete base and asphaltic oil wearing surface, 150,000 sq. ft. of grading and paving with macadam base and asphaltic oil wearing surface, 67,000 sq. ft. cementing cobblestone gutter, and 56,000 sq. ft. of concrete gutters. Plans and specifications from B. B Mann, city engineer.

ORANGE—Bonds for $10,000 for bridge across Santiago creek have been sold.

ORLAND—City Trustees have awarded contract for construction of extension work on sewer and water systems to G. E. Vincent, of Oakland.

OROVILLE—Surveys have been made for extension of Feather River canal, and construction will probably be started shortly. Brown-Walker-Simmons Co., Crocker building, San Francisco, is interested.——Board of Supervisors will receive bids until 1:30 p m., December 7, for construction of steel truss bridge, 78 ft. long, over west branch of Feather river near Las Plumas. C. F. Belding, county clerk.——Bridge will be constructed across Dark canyon. Cost $2200. County and Great Western Power Co. will divide expense.——C. L. McErneny, Balboa building, San Francisco, has filed on 10,000 inches of water in Little West Branch. It is planned to irrigate 8000 acres in vicinity of Paradise.

OXNARD—L. B. and A. L. Valk, 426 Stimson building, have completed plans for Methodist church. Cost $15,000.

PACOIMA—P. V. Tuttle and A. W. Angel, 619 Delta building, Los Angeles, are preparing plans for school building. Cost $15,000.

PALO ALTO—W. P. Bender is planning erection of oil refining plant.

PASADENA—Representatives from Alhambra, Pasadena, and South Pasadena City Councils have agreed on plans for common outfall sewer.

PASADENA—C. A. Baldwin, 553 S. Marengo avenue, has been awarded contract for improving one block of Division street. ——J. C. Kinsman, 372 N. Fair Oaks avenue, was low bidder for constructing 148,000 sq. ft. of 4-in. oil macadam pavement on East Orange Grove avenue at 6.9c. per square foot.

PETALUMA—Brainerd Jones is preparing plans for construction of school at Fair and Douglas streets. Cost $100,000.

PORTERSVILLE—Bids will be opened December 7 for grading and paving about 50,000 sq. yd. with 1½-in. asphalt concrete pavement on 5-in. concrete base (Topeka specifications). I. H. Althouse, city engineer.——City Engineer Althouse is to report on additional sidewalks.——Tulare Mining Co., owner of magnesite mines in this vicinity, is planning to move reduction works from Redwood City.

POMONA—Crandall Construction Co., 706 San Fernando building, Los Angeles, has been awarded contract for construction of nine miles of street paving, with 4 in. concrete base and 1½-in. Topeka asphaltic wearing surface, at 11.7c. per square foot. The Palomares Hotel & Theater Co. will erect a hotel to cost about $180,000 on site of old Palomares hotel. J. C. Poole, Los Angeles, is architect.

RAVENDALE—Nevada, California & Oregon railway will extend line from here to Surprise valley. R. M. Cox, Reno, Nevada, general manager.

REDONDO—Bids will be received by E. C. Thomas, clerk of Board of Trustees, until 11 a.m., December 5, for kindergarten building and brick addition to school building. Plans and specifications from L. B. Pemberton, 807 Auditorium building, Los Angeles. Cost about $4500.

RED BLUFF—C. E. Cotton, San Francisco, was awarded contract for construction of eight concrete bridges on State Highway from Glenn County line to Corning. Bid was $24,723. Other bids were William Stephens, $28,350; Chico Construction Co., $25,985; Walcott & Brunk, $27,850.——Election has been ordered for December 10 for voting on $85,000 bonds for municipal water system.

REDWOOD CITY—Board of Supervisors has awarded contract for bridge to Barrett & Hilp, San Francisco, at $5308. Also for bridge to Savage Bros., San Francisco, at $6759.——Duncan-Harrison Co. was awarded contract for foundation of gas-holder for Pacific Gas & Electric Co. Cost $16,000.

REEDLEY—City Trustees will install auxiliary pumping plant. Capacity 600,000 gallons daily.

RIO VISTA—The U. S. War Department has approved the plans for the $150,000 Rio Vista bridge, to be built jointly by Sacramento and Solano counties.

RICHMOND—Plans for a municipal wharf 600 ft. long and 90 ft. wide have been submitted by Haviland & Tibbetts, engineers to the City Council——Plans for sewers of Canal subdivision on west side of city were submitted to City Council. Work will cost about $90,000.——W. R. Brown will erect brick building on Macdonald avenue. Cost $4000.——California Street & Road Improvement Co. will extend Boulevard road for J. Nicholl. Work will be done by day labor.——Plans for lateral sewers in Bay View Park addition have been approved.——J. T. Narbett, architect, has submitted plans for firehouse. Cost $2500.——Santa Fe railroad will build spurs about one-half mile long to Los Angeles brick yard here.

RIVERSIDE—Red Mountain Water Co., incorporated with $100,000 capital, will construct irrigation system in Inyo county. F. A. Little is interested.——Pacific Electric Railway, Los Angeles, will start construction this fall on its extension from Riverside to Corona. Extension will be 8 miles in length. Cost approximately $250,000.——Conners Contracting Co., 709 Higgins building, Los Angeles, has been awarded contract for constructing nine miles of concrete paving at $28,462.

SAUSALITO—Contract for $21,102 for grading streets has been awarded to Taton & Smith, San Francisco. Bids will probably be received in March for surfacing these streets. Leonard L. Hohl is city engineer.

SUSANVILLE—Surveys have been made for $75,000 irrigation project. Scott McArthur is interested. Bonds for municipal water system and for street improvements were defeated.

SALINAS—County has voted bonds of $570,000 for roads and bridges.——W. L. Gilham & Sons, of San Jose, were the only bidders on bridge over Pajaro river near Aromas at $9000. Bid was rejected. Engineer's estimate $4300.

SACRAMENTO—J. D. Crummey, of San Jose, has presented plans for water supply system from wells costing $200,000.——Contract for improving Donner avenue has been awarded to Clark & Henery Construction Co.——Capital National Bank will erect $250,000 building at Seventh and J streets. A. Anderson is president.——City will expend $5000 for repairs to levee below Y street.——T. P. Costello has been awarded contract by North Sacramento Land Co. for street and sidewalk. Cost $20,000.——City Commission will call for new bids on construction of units A and B of the trunk line sewers. Work will cost about $40,000. ——R. A. Herold is preparing plans for county hospital. Cost $700,000.——G. W. Peltier will erect building on Eighth street between J and K. Cost $8000. State Engineering Department will spend $12,000 on improving Sacramento river near Chico and Knights Landing, conditional upon property owners of district raising an equal sum.——C. W. Cross, of Oakland, was awarded contract for construction of State Highway from Willows south to Colusa County line, 8½ miles long. Bid $40,913.60. State will furnish material costing $37,760.20. Rochett, Kearney & Co., of Los Angeles, was awarded contract for branch highway from Williams to Colusa. Cost $53,437.90.——Ross Construction Co. has been awarded contract for constructing a sewer in the annexed districts from the drainage canal south of Y street to the new city sump being built near the Riverside baths, upon bid of $58,000.——Bids will be received at office of State Highway Commission, 515 Forum building, until 2 p.m., December 14, for construction of following portions of State Highway. Siskiyou county from Hornbrook to Yreka, about 16.9 miles long to be graded. Sutter county from Yuba City to northerly boundary, about 11.7 miles long, to be built of portland cement concrete. Los Angeles county from section 17, T. 6 N., R. 17 W., S. B. B. & M. to Liebre mountain, about 14.5 miles long, to be graded. Orange county from San Juan Capistrano to Galivan, about 5.5 miles long, to be built of portland cement concrete. ——State Highway Commission has awarded following contracts: To A. W. Gorrill for highway between Folsom and easterly boundary of Sacramento county; cost $39,141.10. To P. L. Burr for road between Batavia and Vacaville; cost $44,679. Bids for highway in Santa Barbara county between Zaca station and Los Alamos were rejected. Bids will be received at next meeting for highway in Yolo county, between Route 7 and Davis in Yolo Basin district, 1.16 miles; in Eldorado county, west of Placerville, 0.026 miles; in Butte county, between Chico and Lindo channel, 1.45 miles.——Bids were opened November 9 for

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state highway work as follows: Imperial county, Division VII, Route 12, Section B: W. F. Callahan and P. L. Hedrick, El Centro, $63,233.10; Rice & Dulcher, Imperial, $72,173.80; Brashear-Burns Co., Los Angeles, $79,035.10; J. W. Calback, San Diego, $76,778.60. Solano county, Division III, Route 7, Section B: Fred Leffler, San Francisco, $47,256; Tieslau Bros., San Francisco, $48,363; Commary Peterson Co., Inc., San Francisco, $49,473; P. L. Burr, San Francisco, $42,831.90; P. H. Hoare, Oakland, $40,357; Bates, Borland & Ayer, Oakland, $45,717.20; A. W. Gorrill, San Francisco, $47,431.30. Colusa county, Division III, Route 15, Section A: A. W. Gorrill, San Francisco, $61,753.50; E. T. Johnson, Portland, Oregon, $57,090.75; Bates, Borland & Ayer, Oakland, $58,883.60; Petersen & Grier, San Francisco, $66,582; Tieslau Bros., San Francisco, $66,408.50; P. L. Burr, San Francisco, $60,357.55; C. W. Cross, Oakland, $55,061.80; Rochell, Kearney & Co., Los Angeles, $55,437.90. Glenn county, Division III, Route 7, Section A: Fred Leffler, San Francisco, $47,530; Petersen & Grier, San Francisco, $49,999.20; Tieslau Bros., San Francisco, $50,640; P. L. Burr, San Francisco, $46,310.60; C. W. Cross, Oakland, $40,813.60; Chico Construction Co., Chico, $41,726.40; P. H. Hoare, Oakland, $50,462.40; Rochell, Kearney & Co., Los Angeles, $40,917.20; Bates, Borland & Ayer, Oakland, $52,294; E. T. Johnson, Portland, Oregon, $43,412. Glenn county, Division III, Route 7, Section A: A. W. Gorrill, San Francisco, $49,216.28.——Hughes Construction Co. was awarded contract for constructing curbs and gutters on E street, from 25th to 31st streets.——State Highway Commission has rejected bids for construction of State Highway from Zaca station to Los Alamos.——State Highway Commission has awarded contract for highway between southern boundary of Glenn county and Willows, 8.5 miles, to C. W. Cross, of Oakland; and of highway between Cordelia and Fairfield in Solano county, 8.1 miles, to P. S. Hoare, Bacon building, Oakland.——F. B. Sutliff will erect building at Fourth and I streets, costing $25,000.

SAN BERNARDINO—Bids will be received until 7:30 p.m., December 7, for constructing sewer in Willis avenue. S. G. Batcheler, city clerk.——Holton Power Co. proposed to build a substation at El Centro, cost $45,000; transmission line from El Centro to Seeley and Dixieland, cost $12,078; transmission line from Banning to El Centro, $221,887; substation at Coachella, cost $1768; and distribution system at same place, cost $58,000.——Following contracts have been awarded for new polytechnic high school: To Hoagland-Hulse Co., of Los Angeles, heating system for $19,972; to F. O. Engstrum Co., of Los Angeles, wiring system for $5100; to Wormell & Drabaugh, of Pasadena, painting for $9235.——George C. Condon, Citizens National Bank Bdg., Los Angeles, was awarded general contract at $94,200 for administration and mechanics building for polytechnic high school.——Cresmer Manufacturing Co., Riverside, was awarded general contract at $82,991, for classics, science, and home economics building.——Preliminary surveys have been commenced for system of county highways provided for at recent bond election.

SAN DIEGO—J. F. Over was low bidder for constructing two miles of concrete roadway on Torrey Pines grade at $0.058 per sq. ft. for Class A, and $0.035 per sq. ft. for Class B; catchbasins, $7.50 each.——Cuyamaca water system has been sold to La Mesa water district.——Holland Construction Co. was awarded contract for building float at municipal pier. Cost $3725 ——California-Jewell Filtration Co. will be awarded contract on filtration system.——Llewellyn Iron Works, Los Angeles, has been awarded contract for 24-in. steel pipe-line. Cost $59,400.——State Railroad Commission has authorized the Southern California Mountain Water Co. to sell its Highland Reservoir pipe-line to the Coronado Water Co. for $165,350.94. ——Fairchild-Gilmore-Wilton Co. has been awarded contract for asphalt pavement on 16th street.——Paumo Valley Water Co., organized by J. Moore, Jr., J. C. Adams, and G. M. Henderson, with capital stock of $300,000, will construct irrigation system to water about 12,000 acres.

SAN FERNANDO—San Fernando irrigation district has voted bond issue of $2,606,000. Irrigation system will cover 76,080 acres. Water will be taken from Los Angeles aqueduct.—— J. C. Austin, architect, 1125 Baker Detwiler building, Los Angeles, is preparing plans for high school building. Cost $130,000.

SAN FRANCISCO—Contract was awarded to Foster-Vogt Co., Sharon Bdg., for pavilion on Exposition site for Canadian Pacific Railway. Cost $12,574.——Contract was awarded to Lange & Bergstrom, Sharon Bdg., to erect exhibit at Exposition ground for Westinghouse Electric & Manufacturing Co. Cost $16,622.——Following street work has been ordered: Rhode Island street, between 19th and 20th, curbs; Alma street, between Cole and Belvedere, sidewalks; O'Farrell street, between Larkin and Polk, sidewalks; Bay street, between Polk and Van Ness, sidewalks; 42nd avenue, between Irving and Judah, sewers; 44th avenue, between Clement and Point Lobos, curbs and basalt and asphalt pavement; 29th avenue, between Anza and Balboa, curbs and asphalt pavement; Irving street, between 47th and 48th avenues, sewers; 47th avenue, between Lincoln way and Irving street, sewers.——Board of Public Works will receive bids until December 2 for construction of power-house at Civic Center.——Union Iron Works will construct drydock costing $2,000,000 at Hunter's Point.——Marin County Electric Railway has filed application with Railroad Commission for authority to start construction at Mill Valley. Cost $35,000.—— Board of Public Works has authorized asphalt pavement on Sloat boulevard for entire length; also $220,000 for street improvements.——James F. Whittelsey, Claus Spreckels Bdg., has suggested a plan to the Board of Supervisors whereby an expenditure of $125,000 the city can generate electricity for the buildings at the Civic Center.——Twin Peaks tunnel contract, formally awarded to R. C. Storrie & Co., Oakdale and Quint streets, San Francisco, upon its bid of $3,372,000.——Plans have been prepared for addition to Lane Hospital, costing $100,000. Bakewell & Brown, architects.——Plans are completed for addition to Concordia Club, costing $65,000. G. A. Lansburgh, architect.——Plans completed for apartment building, Sixth and Shipley streets. Cost $50,000. Rousseau & Rousseau, architects.——Plans completed for three-story apartment house at Sixth and Irving streets. C. H. Rousseau, architect.——Plans are completed for house for S. Lowenstein. G. A. Lansburgh, architect.——H. Sandberg, 5 Miguel street, has been awarded contract for concrete work for apartment building on O'Farrell street, at $10,500.——Board of Public Works has awarded contract for constructing shop building for department of electricity on Golden Gate avenue, between Leavenworth and Hyde streets, to T. E. Davis & Son, for $13,269.——Kiernan & O'Brien will erect a $40,000 apartment building on Mason street south of Sutter. Rousseau & Rousseau are architects.——The following street improvements have been ordered: Sewers on Valley street between Castro and Diamond; sewers on Dwight street between San Bruno avenue and Barton street; Sewers on Howth street between Ocean and Geneva avenues; and sewers on Ridge lane between Josiah and Howth streets, on Milton street between Springdale street and the Southern Pacific railway. Grading and construction of sewers on Balboa street between 45th and 46th avenues. Sidewalks on Larkin street between O'Farrell and Olive streets. Curbs, sidewalks, and roadway on 38th avenue between Balboa and Cabrillo streets. Grading, sidewalks, sewers, and pavement on Lakeview avenue from San Jose avenue to Lee and Summit avenues. Curbs and paving on Laidley streets between Miguel and Castro streets. Curbs and paving on Filbert street between Baker and Lyon streets.——Board of Works has asked for bids for paving Corbett avenue from Stanford Heights to the United Railroad tracks at Sloat boulevard. Pavement will be asphalt on concrete base.——Board of State Harbor Commissioners has awarded contract for paving piers 16 and 18 for $10,275, and pier 37 for $8000, to Rolph, Mills & Co., Rialto building.—— A. G Headman, architect, new Call building, has prepared plans for pathological building for City and County Hospital. Cost $75,000.——J. R. Hanify, 24 Market street, has been awarded contract by Kiernan & O'Brien to erect building at Eddy and Fillmore. Cost $30,030.——Strehlow, Freese & Peterson, Exposition Grounds, San Francisco, have been awarded contract for construction of Mississippi State building, at Exposition grounds. ——Southern Pacific Co. has been authorized by State Railroad Commission to spend $1,426,000 for 30 locomotives, 30 steel passenger cars, and 30 steel electric motor-cars for suburban traffic.——Bids will be received by Bureau of Supplies and Accounts Department, Washington, D. C., for the following articles: December 15, for delivery at Mare Island, California, 150 complete renewals for type Q Edison battery; 1060 sockets, key, brass, $\frac{1}{8}$ to $\frac{3}{8}$-in. caps; 84 lb. nickel chromium alloy wire; 10,000 lb. plate zinc, $\frac{1}{2}$ by 24 by 48 in.——Until January 5, for delivery at Pearl Harbor, H. T., 6000 lb. railroad spikes, galvanized $\frac{1}{16}$ by 5$\frac{1}{2}$ in.; 76,000 ft. redwood ties; 9 valves, flanged ends, wedge gate, 3, 8, and 10 in.; miscellaneous quantity of steel cross-ties, 6 ft. long; miscellaneous quantity of open-hearth steel rails. Particulars from the Purchasing Pay Officer, U. S. Navy Pay office, San Francisco, California.——Plans are being prepared by Smith & Stewart, 244 Kearny street, for store and garage for A. H. Martin; cost $8000.——Henry C. Smith, Humboldt Bank building, is preparing plans for reinforced concrete apartment house. Cost $60,000.——Contract for construction of building for Third Church of Christ, Scientist, has been awarded to Arthur Arlett, Sheldon building. Cost $80,000.

SAN JOSE—College Park sanitary district will hold election December 23 to vote sewer bonds for $10,000.——Concrete gutters and curbs have been ordered on San Augustine street and on 11th street. R. E. Walter, city clerk.——I. Meyerholz has been awarded contract for erection of reinforced bridge over

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Stevens creek.——John McReynolds was awarded contract for constructing bulkhead on South 17th street in Coyote creek. Cost $1956. McReynolds also bid on sections to be improved by property owners, $1795 and $3049.——Board of Supervisors will open bids December 21 for fitting up Santa Clara and Alameda counties' building at San Diego exposition. H. A. Pfister, county clerk.

SAN MATEO—Knights of Columbus Hall Association will erect building. Cost $50,000. W. D. Shea, 244 Kearny street, San Francisco, architect.

SANTA ANA—George Wiegand, Lamanda Park, was awarded contract for improving about four miles of Brea Canyon road at $23,036.24. Other bidders were: Easley Construction Co., $24,139.16; Fred Hoffman, $24,260.92; Brashear-Burns Co., $25,268.02; Oscar Ford, $26,949.61; Hart & Ducey, $27,057.82; O. & C. Construction Co, $28,867.50; Richard Rothwell, $31,819.83. Engineer's estimate, $25,091.45.——M. L. Huberman was awarded contract for concrete pavement on Bradford avenue, Placentia, at $5533.66.——O. & C. Construction Co, of Fullerton, was awarded contract for five miles of road from La Habra to Brea. Cost $89,179.

SANTA BARBARA—Board of Supervisors appropriated $3000 for paving Los Olivos street.——Santa Barbara Gas & Electric Co. has applied for franchise for extension of its gas system. ——Contract for erecting bath-house for Southern California Edison Co. was awarded to F. O. Engstrum Co., Los Angeles, and for ironwork to Los Angeles Steel & Iron Works and Baker Iron Works, Los Angeles. Cost complete about $60,000. ——E. P. Edwards has been awarded contract for building for Howard-Canfield Building Co. Cost $7000.——F. R. Ritchie Co., Crocker Bdg., San Francisco, has been awarded contract for improving Valerio and Hollister streets. Cost about $90,000. ——Plans are being prepared for nine concrete bridges over de la Cuesta canyon and Zaca canyon.

SANTA CRUZ—Contract for building fish-houses on municipal wharf awarded to W. A. White for $735. Other bidders: Hihn Investment Co, $941.75; G. W. Reid, $897.55; Thies & Wallace, $1114.——City Engineer instructed to furnish estimate of cost of plans and specifications for completion of Water Street bridge and for two Branciforte Creek bridges.——Thomas H. Day's Sons, Wells Fargo building, San Francisco, will complete Branciforte grammar school.——Bid of G. C. Pratchner for making new grade near Majors creek of $1961 was rejected, and work will be done by day labor.

SANTA MONICA—J. A. Morton, city engineer, is preparing plans and specifications for $225,000 system of storm drains.

SANTA ROSA—Following bids were submitted for street cleaning plant: Edward R. Bacon Co., San Francisco, $1635; Harron, Rickard & McCone, San Francisco, $1668.65; Parrott & Co., San Francisco, for three different machines, $1542.50, $1925, and $2450.

SIERRA MADRE—W. Mulholland, Los Angeles, will report on addition to water system.

STOCKTON—Board of Education will call for bids for house over high school swimming tank.

SUNNYVALE—Joshua Hendy Iron Works was awarded contract for pumping station. Cost $11,740.

TERRA BELLA—Plans are being considered to impound water of Deer creek to irrigate 10,000 acres in this vicinity.

TULARE—Contract for five concrete bridges awarded to Parlier Construction Co. for $2495.——Theatre costing $20,000 will be erected. D. S. Taylor is interested ——Plans for system of electroliers are being considered by City Council.

TURLOCK—Water Superintendent G. H. Tabor advises installation of another pump with capacity of 1000 gallons per minute. Estimated cost $3000.——Contract for erection of addition to Swedish Mission Church was awarded to S. Wakefield at $4725.——T. Olson has awarded contract for one-story brick building to Tornell & Larson. Cost $4000.

UPLAND—Southern California Contracting Co., of Ocean Park, has been awarded contract for improving San Antonio avenue, between 10th and 23rd streets, at $58,000. Work will include approximately 421,800 sq. ft. of concrete paving and 32,845 lin. ft. of stone curbing.

VACAVILLE—Trustees have approved plans for Carnegie library. Cost $15,000.

VENICE—City Council contemplates spending $30,000 for outfall sewer and septic tanks.

VENTURA—County Commissioners rejected all bids for county hospital and new bids will be received about January 1, 1915 ——The following contracts have been awarded for reinforced concrete culverts and bridges: Culvert No. 1, to A. Pefley, 431 West 47th place, Los Angeles, at $1175; culvert No. 2, to S. M. Kerns, Bennie apartments, 625 W. Ocean avenue, Long Beach, at $1450; culvert No. 3, to Mercereau Bridge & Construction Co., Los Angeles, at $1215; for bridge 4a to Mercereau Bridge & Construction Co, at $2206; and for bridge 5a to A. Holloway, Pasadena, at $2052.

VISALIA—Board of Supervisors has set December 3 as the date for good roads bond election. Issue is for $1,488,555.—— Bonds for $12,000 for fire apparatus were carried. Bonds for sewer extension and purchase of sewer farm were defeated. ——Board of Supervisors will receive bids until 11 a.m., December 7, for bridge over Cottonwood creek. A. M. Coburn, clerk of board.——L. Lucier will erect apartment house. Bowen & Davis, Fresno, California, architects.

WATSONVILLE—T. Electric Co. has been awarded contract for installing electrolier lighting system in East Third street from Main to Alexander.

WEAVERVILLE—Board of Supervisors of Trinity county has approved plans suggested by U. S. Forest Service for joint construction of roads by federal government and Trinity county. Plans involve expenditure of about $500,000.

WINTERS—Election will be held December 19 to vote $50,000 bonds for high school.

WHITTIER—P. V. Tuttle and A. W. Angel, 719 Delta building, Los Angeles, are preparing plans for one-story brick grammar school building. Cost about $25,000.

WOODLAND—Jenkins & Wells, of Sacramento, have been awarded contract for bridge over cut now being made in Knights Landing ridge by drainage district. Cost $14,000.—— Boards of Supervisors of Yolo and Solano counties have awarded contract for bridge over Putah creek on new state highway to the Clinton Fireproofing Co. of San Francisco. The bid was $30,500 for the structure, with 27½c. additional per lineal foot for extra wood piling bracing in the centre.—— School costing $100,000 will be erected. W. H. Weeks, 75 Post street, San Francisco, architect.

YUBA CITY—Application of trustees of reclamation district No. 1500 for a modification of injunction to permit them to construct the east levee of their project, was denied by Superior Judge Emmett Seawell.

IDAHO

LEWISTON—Franchise was awarded A. G. Nortz for streetcar line across interstate Lewiston-Clarkston bridge.——County Engineer Booth has completed survey and estimate for link in state highway, from Lewiston to a connection with the Washington State highway. Length 10.3 miles. Estimated cost $52,000.

MOSCOW—The Council has awarded a paving contract for the extension of the University district to George E. Wycoff, of Spokane, for 6-in. crushed concrete with ½-in. bitumen wearing surface at $1.42 per square yard.

POCATELLO—Jesse Coogan Engineering Co., 404 State street, Salt Lake City, has been awarded contract for heating system in shop buildings and roundhouse for Oregon Short Line. Also contract for power-plant equipment, plumbing, and heating in Union depot for Union Pacific railroad.

TWIN FALLS—Contract for road and bridges on 50 miles of road was awarded to Helmer & Mull.

WALLACE—Petitions are being circulated to call for a special election to authorize bonds to meet the expense of paving street intersections in a district covering 20 blocks. Because of width of streets, it is planned to have 8-ft. parkway in the centre, leaving a roadway of 21 ft. on either side. Ornamental concrete bridges of the Venetian type with ornamental lights, would be constructed over the South Fork at Sixth and Cedar Street crossings.

WEISER—The landowners of the East Weiser irrigation district have voted $16,000 in bonds. Proceeds will be used in the Old Town section.

MONTANA

GREAT FALLS—Bids will be received at office of U. S. Reclamation Service until 2 p.m., December 8, for construction of part of Pishkum Reservoir supply canal, involving about 68,000 cu. yd. excavation, 1600 cu. yd. concrete, placing 245,000 lb reinforced steel, placing 28,000 ft. B. M. lumber. Work is on south side of Sun river, in Lewis and Clark county, about 20 miles northwest of Gilman. Plans from U. S. Reclamation Service, Washington, D. C., Great Falls, Montana, or Fort Shaw, Montana.——Bids will be received at office of U. S. Reclamation Service until 2 p.m., December 22, for earthwork on Greenfields distribution system, involving about 385,000 cu yd. excavation. Work is on north side of Sun river, about 25 miles northwest of Great Falls, about six miles north of Fort Shaw. Particulars from U. S. Reclamation Service, Washington, D. C., Great Falls, Montana, or Fort Shaw, Montana.

ST. IGNATIUS—Bids will be received at office of U. S. Reclamation Service until 3 p.m., December 15, for construction of about 38 miles of canals and laterals. Total excavation 106,000 cu. yd. The work is situated on each side of Flathead river, about 18 miles southwest of Polson, and 8 miles west of Ronan.

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Plans from U. S. Reclamation Service, Washington, D. C., Great Falls, Montana, or St. Ignatius, Montana.

NEVADA

HAZEN—J. W. French, Riverside, California, and F. A. Campbell, of Bishop, California, have been awarded contract and subcontract, respectively, for construction and extension of power line for Nevada Valley Power Co., from Lahontan into Rochester, by way of Hazen and Lovelocks. Work will cost about $220,000. W. H. Leffingwell, chief engineer.

ROUND MOUNTAIN—Round Mountain Mining Co. will build a pipe-line eight miles long. R. E. Ernest, superintendent.

NEW MEXICO

SANTA FE—City will install ornamental street-lighting system.

OREGON

ALBANY—Contract for erecting union high school building was awarded to H. E. Hoover. Cost $50,000.

ATHENA—Goph Bros., La Grande, submitted low bid for construction of school building; cost $22,475. Western Stove Pipe Co., 492 Alder street, Portland, $2918, low bid for heating. S. W. Kratz, $1279, for plumbing.

BAKER—Engineer L. R. Stockman, has reported favorably on project for municipal hydro-electric development. Total estimated cost, $180,540.12.——Third street will be improved from Miller to Colorado.

THE DALLES—George Isackson, of Portland, was low bidder for construction of post-office building. Bid $76,000 for limestone and $73,000 for sandstone.——Board of Commissioners of Wasco county has awarded contract to Albert Frederick for two reinforced-concrete bridges. Cost $12.90 per cu. yd. for concrete and $3.30 per 100 lb. for iron.——Oregon-Washington Railway & Navigation Co. will build roundhouse costing $140,000.

EUGENE—Clark & Henery Co., of Sacramento, submitted lowest bid, $28,235, for paving 6th avenue west from Olive to Blair boulevard. Warren Construction Co., of Portland, Oregon, bid $28,919.

GRANDVIEW—Meeting has been held for formation of irrigation district in this vicinity, covering 15,000 acres. W. A. Bell, The Dalles, Oregon, is interested.

HOOD RIVER—Contract for constructing headworks for East Fork irrigation district was awarded to Andrus & Bode Co., of Portland, at $19,160.——The Stanley Smith Lumber Co. will rebuild its sawmill. Estimated cost, $65,000.

KLAMATH FALLS—Bonds for $25,000 have been sold for improving Eighth street.

LA GRANDE—Houghtaling & Dougan, architects, Henry building, Portland, Oregon, are preparing plans for parochial school. Estimated cost, $75,000.

LAKE VIEW—City Engineer Lewis has approved plan of Goose Lake Valley Irrigation Co., which expects to complete, within the next few months, its reservoirs and main canal lines, at a cost of approximately $1,000,000. The company proposes to supply water for the irrigation of 46,500 acres of land.

MONTAVILLA—Bids will be received for Willow and East 82nd Street branch sewer. Estimated cost, $183,000.

MARSHFIELD—Contract for construction of gymnasium awarded to J. M. Wright; cost $8125. Contract for plumbing and heating to Pioneer Hardware Co.; cost $1282.17.

PORTLAND—Willamette Iron & Steel Works was awarded contract for repair of steamer 'Santa Catalina.' Cost $300,000.——MacNaughton & Raymond have prepared plans for building for Blake McFall Paper Co. Cost $90,000.——First National Bank will erect building at Fifth and Stark streets. Cost $400,000. Shepley, Rutan & Coolidge, of Boston, Mass., are architects. D. C. Lewis, local architect.——Whitehouse & Fouilnoux have prepared plans for buildings for Catholic church on 17th street, costing $250,000. Contract for one building, a parish school, was awarded to D. F. Campbell. Cost $35,000.——Following bids have been received for grading and sidewalks on 57th, 58th, Sacramento, Thompson, Tillamook, and Hancock streets: Star Sand Co., $7871.10; Cochran, Nutting & Co., $8511.25; George Gundlach, $8343.31; O. M. Patton, $7996.01; Giebisch & Joplin, $8099.44; Manning Co., $8299.57.——R. E. Kremers, chief of Bureau of Highways and Bridges, has estimated the cost of removing the old submerged piers under the Morrison Street bridge at $5000. Bids are being called.——Plans have been prepared for improving East Grant street from west side of Grand avenue to line of East 11th street, using Hassam pavement. Estimated cost, $14,258.——M. J. Walsh, 311 Stark street, was awarded contract for lighting system in Columbia and Peninsula park. Cost $2248.——The contract for the construction of a factory of the Portland Oxygen & Hydrogen Co., at 17th avenue near Center, has been awarded to W. C. Moore.——Contract for Couch school was awarded to Boyajohn-Arnold Co.; cost $115,584. Contract for heating to W. W. Cox & Co.; cost $26,038.——Sufficient bonds of $1,000,000 joint issue for bridge over Columbia river between Portland and Vancouver, Wash., have been sold to insure commencement of work.——Contract was awarded to Edward Sandeberg for Long Avenue and 45th Avenue southeast sewer system. Cost $15,064.——City Commission awarded contract to Jeffrey & Hufton for repairs to Grand Avenue bridge. Cost $7900.——School Board will advertise for bids for erection of Richmond school. Cost $55,000.——Commonwealth Realty Co. will build apartment house on Sandy road. Cost $18,000. Goodrich & Goodrich, architects.——Bids for delivery of 450,000 tons of rock at Fort Canby for use on north jetty, will be opened at office of Col. McKinstry, U. S. Corps of Engineers, at 10 a.m., December 16.——Contract for construction of two-story building for Mrs. C. Backstrom was awarded to John Hedstrom, 756 Kerby street. Cost $10,000.——Terry & Harris, Yeon building, Portland, are having plans prepared for the construction of a plant for the manufacture of cast iron water and gas pipe and fittings. Estimated cost, $100,000.——Port Commission has rejected bids for fill of dock No. 1, which will require 10,000 cu. yd. of material because prices were too high.——U. S. Engineers Office, Couch building, will open bids December 7 for eight steel swing bridges across Dalles-Celilo canal between Celilo and Big Eddy, Oregon. Seven spans are 65 ft. and one is 45 ft.——Olson & Johnson, of Missoula, Mont., were low bidders for construction of Shattuck school. Bid $111,485. Other bids were: Boyajohn-Arnold Co., $116,975; Butler Contracting Co., $117,860; Bingham & Shelley, $117,899; Litherland & Avery, $118,342; Brayton Engineering Co., $121,875; J. S. Winters & Co., $123,987; John Almeter, $127,052; and Pearson Construction Co., $132,646. Alaska Plumbing Co. was low bidder on heating contract; cost $23,858. Sturges & Sturges were low bidders on plumbing; cost $10,542.——Trunk sewer in Fulton park and Carson heights is proposed. Cost $34,604.

PRAIRIE CITY—Citizens of Prairie City and Long Creek have voted to construct road 30 miles long connecting these towns.

SUTHERLIN—L. G. Hicks, Perkins building, Roseburg, Oregon, is preparing plans for eight blocks of concrete pavement 24 ft. wide with concrete curbs.

SALEM—H. L. Bowlby, state highway engineer, has furnished estimates for constructing bridge over Willamette river. Cost varying from $188,583 to $273,294, according to location.

WARRENTON—Bonds for $150,000 have been voted for constructing water system.

UTAH

OGDEN—Utah Cereal Food Products Co. will move its principal offices from Salt Lake City here and erect a plant, including sixteen steel elevators for storing grain. Total cost of plant estimated at $120,000. Lon J. Haddock, treasurer and manager.——City Commission has decided to spend $100,000 for pipe-line for water system. Length 5½ miles. Construction will be commenced in the spring.

SALT LAKE CITY—Plans have been completed for two passenger stations for the Salt Lake & Utah railroad at American Fork, costing $6500, and Provo, costing $10,000.——J. W. Mellen has been awarded a contract for resurfacing Sixth East street for $15,325.——City water officials have selected site for reservoir to be built in Parley's canyon, to store approximately 1,000,000 acre feet of water. Money for the first unit of the reservoir was obtained by the bond issue authorized last February, and City Commission plans to let the contract early next year.——Committee sent by State Railroad Commission to investigate feasibility of improving road through Logan canyon to Bear lake, and then to Evanston, Wyoming, has made favorable report. Committee is W. D. Beers, state engineer; E. R. Morgan, state road engineer; and William Peterson, member of State Road Commission.——Plans for school building at 10th and 15th streets approved. F. D. Rutherford, architect.

WASHINGTON

BLANCHARD—Stone & Webster Engineering Corporation will organize a company to supply electricity to Blanchard and Edison and surrounding country, and erect sub-station at Edison. W. E. Herring, Puget Sound Traction, Light & Power Co., Seattle, Wash., is interested.

BUCKLEY—C. W. Raymond, 804 Spalding building, Portland, Oregon, was awarded contract by Commissioners of King and Pierce counties for furnishing steel for bridge over White river at Buckley. Cost $11,625.

BELLINGHAM—Contract for plumbing on 14th Street school building was awarded to Munroe & Haskill; cost $3292.15. Contract for electrical work to Clark Electric Co.; cost $1348.

CAMAS—The Camas Water Co. has been incorporated by O. L. Price, Camas; Milton Hegstad, Portland, Ore.; and H. L. Sound, Vancouver, B. C., with $50,000 capital. Company will construct water system to supply Camas.

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CONCONULLY—Illinois Steel & Bridge Co. has been awarded contract for construction of Mallott bridge. Cost $10,500.

COLFAX—F. E. Martin, of Spokane, has been awarded contract for building St. John's Academy. Cost $30,500.

ELLENSBURG—Cascade Irrigation Co. will replace wooden flume with steel. Cost $100,000.

EVERETT—Burns & McDonnell, Scarritt Bdg., Kansas City, Mo., has submitted plans and estimates for proposed municipal water works.

KEYPORT—The Port Commission of the Port of Pearson is considering plans for harbor improvements. M. D. Richardson is secretary.

NORTH YAKIMA—Union Oil Co. will construct distribution plant here. Cost $15,000. C. L. Quist is local manager.——City Engineer's Department is preparing plans for paving First avenue.

OLYMPIA—Contract to surface two miles of Pacific highway south of Woodland in Clerk county has been awarded to Hayden Brothers & Bidwell, of Portland, Ore. Price $6960.——Gen. W. L. Marshall, U. S. Reclamation Service, and I. D. O'Donnell, representing the state of Washington, are investigating Palouse irrigation project

PORT ANGELES—The Canal Lumber Co., Seattle, has been awarded contract for 450,000 ft. of planking and bridge timber, for grading, trestle work, and sidewalks in this city, to Engstrand & Anderson, Seattle.

PUYALLUP—Contract was awarded to S. R. Greythe for about one and one-half miles cement sidewalk. Cost $1462.10.——Heath & Gove, Tacoma, are preparing plans for grandstand. Cost $3500.

QUINCY—A movement is on foot to obtain federal aid for Quincy valley irrigation project. State bonds for this project were defeated at the last election.

SEATTLE—Contract for grading Mead street was awarded to R. H. Odman for $2616.55.——Contract for concrete walks on 44th avenue was awarded to B. H. Betler for $1314.85.——Contract for construction of two-story reinforced concrete library was awarded to A. S. Peterson, 4311 Whitman avenue, for $22,700. Contract for plumbing was awarded to F. W. Beck, Lowman Bdg., for $863. Contract for electrical work was awarded to NePage, McKenny & Co. for $329.——Howell & Stokes, Henry Bdg., are preparing plans for four-story reinforced concrete building for P. S. Foust. Cost $200,000.——V. W. Voorhees, Inc., Eifel Bdg., is preparing plans for three-story brick building for L. Anderson; cost $55,000.——G. C. Nimmons, architect, Chicago, Ill., has completed plans for reinforced concrete addition to the plant of Sears, Roebuck & Co., estimated to cost $850,000.——Construction of a concrete tunnel over Dearborn street for a distance of 650 ft. east from 11th avenue south, the extension of 11th, 12th, and 13th avenues south by filling over the tunnel and regrading the above streets from Dearborn street to Judkins, is proposed by a resolution sent to city engineer, A. H. Dimock, for the preparation of plans.——City Engineer A. H. Dimock announces that he has appointed Andrew Munster, Central building, as engineer to assist the department in bridge problems in connection with Ballard and Fremont bridges over Lake Washington canal——Contract was awarded to Pacific States Bridge & Dredging Co., Central building, for canal between Oak Bay and Port Townsend. Cost $51,485.——Contract for paving Dearborn and other streets was awarded to Krogh & Jessen. Cost $30,174.90.——Contract was awarded for roadway on Fairview avenue to C. Geske & Co. Cost $20,824.——Sound Construction & Engineering Co., Lowman building, was low bidder on construction of Ballard high school. P. J. Lavan, Crary building, was low bidder for heating; $33,250. Low bid for plumbing by Peterson Hardware & Plumbing Co., 3511 Ballard building, cost $29,800. Low bid for wiring by NePage, McKenny & Co., Maritime building, cost $8845.——Allis-Chalmers Co. was awarded contract by the Port Commission for building new substation at Smith cove. The company bid $5760.——A. Henegan, 2309 Madison street, will erect a poultry and stock food factory to cost about $65,000.——G. A. Ferguson submitted lowest bid to Board of Public Works for improving Dearborn street; price $30,311. Other bidders: J. S. Kenyon, $31,853.05; Krogh & Jessen, $30,174.90; D. H. Traphagen, $31,763.35; A. J. Baumgartner, $31,307.26; Stilwell Bros, $33,256.80.——Link Belt & Dodge Products Co. has been incorporated for $25,000. L. W. Shirley, of Seattle; P. L. Coonley, of Lake Forest; and M. W. Mix, of Mishawaka, Ind., are incorporators.——County Commissioners have awarded contract to William Martell, P. O. Box 536, Seattle, for building 3 miles of Medina-Bellevue permanent road No. 9 upon his bid of $13,825——City Council has authorized following improvements: Shoreland drive paved. West Stevenson street, from California to 45th avenue, grading, curbing, and sidewalks. Hodson street, from Rainier to 37th avenue, planking. Sixth avenue, concrete sidewalks.——County has voted bonds for $350,000 for addition to courthouse.——City Engineer A. H. Dimock has completed plans for trunk sewer for Ballard district, about 2½ miles long, 64 by 144 in. Cost about $500,000.——Giulio Argentieri, 989 Rainier avenue, was awarded contract for water mains on Graham street for $7011.——Automatic Sprinkler Co. of America was awarded contract for sprinkling system on Hanford Street wharf. Cost $15,584.——Puget Sound Film Producing Co. has awarded contract for constructing film-producing plant, near Renton, to S. G. Combs.——City engineer will make survey for new pipe-line from Cedar river to West Seattle.

SPOKANE—James C. Broad was low bidder for construction of the new down-town intercepting sewer, extending from Lincoln street and Main avenue, at $19,465.——County Commissioners have passed a resolution appropriating $14,000 toward the building of a proposed arterial highway between Spokane and Hillyard, upon condition that city bears its portion of the expense. The city has provided $14,000 in budget for 1915 to care for its 25% of the improvement.——City has passed an ordinance ordering the paving of Market street from South avenue to Rich avenue to be paid for by ten annual payments.——Horse Heaven Land Owners' Association is considering plans for formation of irrigation district. H. M. Street, of Seattle, is president; L. M. Rice, of Seattle, is engineer.——Pacific Concreting Co., of San Francisco, has been awarded contract for placing concrete in Northern Pacific grade separation. Cost $150,000.

SUNNYSIDE—Following bids were received by U. S. Reclamation Service for construction of 13 miles of canal: Valley Construction Co., North Yakima, main contract, $91,625; wood pipe, $15,561. Oregon Bridge & Construction Co., Portland, main contract, $87,653; wood pipe, $13,221. Nettleton, Bruce & Eschbach, Seattle, main contract, $99,720; wood pipe, $18,094. Consolidated Contract Co., Portland, main contract, $96,239; wood pipe, $14,783. George P. Wright, Tacoma, main contract, $81,093; wood pipe, $11,891. McDonald & McGuire, main contract, $197,973; wood pipe, $14,627. Grant, Smith & Co., Seattle, main contract, $96,128; wood pipe, $14,534. Pacific Tank & Pipe Co., Portland, wood pipe, $10,976. Chamberlain Construction Co., Seattle, wood pipe, $12,998. Redwood Mfg. Co., wood pipe, $14,099. Washington Pipe & Foundry Co., Tacoma, wood pipe, $10,777.

TACOMA—The Bellefontaine Bridge Co., Bellefontaine, Ohio, at $11,628, has been awarded contract for construction of two 171-ft. spans for bridge over White river near Buckley by County Commissioners.——County Engineer Thompson is making a survey for a road from Orting to Mt. Tacoma, entering the forest reserve on the north side and passing between the Voight and Carbon rivers. Road will be approximately 40 miles long.

VANCOUVER—The Yaquina Bay Electric Co. has voted to increase capital stock from $20,000 to $40,000 for the purpose of developing power for electric line near Yaquina Bay, Ore.——Port Commissioners have let following contracts: To Elliott Contract Co., of Portland, to construct 2400 ft. of jetty for $3076; to A. A. Lobe, of Portland, to furnish piling at 8c. per foot; cost $4500.

WALLA WALLA—Hans Pederson, of Attalia, was awarded contract for Burbank drainage system. Cost $39,735.

Personal

H. C. FAXON, city engineer of Colton, has resigned.

O. L. DICKESON has resigned the presidency of the White Pass Route.

A. B. COOK has been appointed city engineer for Santa Barbara, succeeding GEORGE P. ROBINSON, resigning.

RALPH BENNETT and J. F. DULING have removed their engineering offices to 1319 Washington building, Los Angeles.

ASHTON & BRIDGMAN, engineers and contractors, have removed their offices from the Foxcroft building to 503 Market street, San Francisco.

RALPH L. PHELPS has severed his connections with the Safety Insulated Wire & Cable Co. and Pierson, Roeding & Company.

GENERAL WILLIAM MARSHALL, consulting engineer of the U. S. Reclamation Service, has been investigating the Palouse project in Washington.

ROBERT C. WYGANT, formerly assistant in the office of the state engineer of Oregon, has opened an office for private practice at Salem, Oregon.

O. W. PETERSON, of the U. S. Reclamation Service, is mak-

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ing investigations in Shasta county in connection with the Pit River and Iron Cañon projects.

M. Roy Thompson, county engineer at Pierce county, Washington, has been appointed senior highway engineer in the U. S. Department of Public Roads.

A. C. Balch, vice-president and general manager for the Southern California Gas Co., has resigned, and will be succeeded by A. C. McBeth, of Kansas.

F. O. Martin, W. L. Watts, W. H. Burnett, and C. E. Hitchler, of the U. S. Geological Survey, are making a tour of inspection of the San Joaquin Valley oilfields.

B. E. Hayden, of the U. S. Reclamation Service, formerly irrigation manager at Fallon, has been appointed project manager of the Belle Fourche project, South Dakota.

W. H. Ellison and V. B. Stanbery, both of whom were recently employed by the California State Engineering Department, have opened offices at 251 Kearny street, San Francisco.

A. Munster, of Seattle, has been appointed by the City Engineer in a consulting capacity with reference to construction of Ballard and Fremont bridges over Lake Washington canal.

A. M. McSweeney has joined the firm of Headlund & Kent, which will be hereafter known as Headlund, Kent & McSweeney, architects and structural engineers, Salt Lake City and Pocatello.

Frank A. Randall, Associate Member American Society of Civil Engineers, and William H. Warner, Associate Member Western Society of Engineers, have opened offices at 511 Rector building, Chicago.

J. Vipond Davies, vice-president of Jacobs & Davies, Inc., consulting engineers, 30 Church street, New York, was awarded, by the Institution of Civil Engineers, the Telford Gold Medal of that Institution for his paper on the 'Extensions of the Hudson River Tunnels of the Hudson & Manhattan Railroad.'

W. F. Allison, professor of hydraulic and sanitary engineering in the University of Oregon, has succeeded E. J. McCaustland as professor of highway and municipal engineering in the University of Washington. Mr. McCaustland has been elected dean of the college of engineering in the University of Missouri.

The Secretary of the Interior has designated General Marshall, consulting engineer for the U. S. Reclamation Service, and A. P. Davis, chief engineer for the U. S. Reclamation Service, and H. T. Cory, consulting engineer of San Francisco, as a committee to review the report of E. G. Thompson, district engineer, of Portland, Oregon, for the U. S. Reclamation Service, with special reference to the preliminary work in examining the proposed Iron Cañon irrigation project near Red Bluff, California. A meeting was held at Red Bluff on November 9, at which a general hearing on the entire project was conducted by the examining board appointed by the Secretary of the Interior.

Commercial Paragraphs

The Edward R. Bacon Co., 51 Minna street, San Francisco, reports the sale of an asphalt roller to the city of San Rafael.

The Beebe Company, Portland, has sold a Kent concrete mixer to W. W. Patterson, contractor, Portland.

United States Steel Corporation has been awarded contract for 152 gross tons steel rails for Tacoma tide flats municipal line.

E. G. Gordon, 55 First street, Portland, district sales agent for Erie City Iron Works, has sold a 600-hp. vertical water type boiler to Knappton Mill & Lumber Company.

Hunt, Mirk & Co., representing the Westinghouse Machine Co., will remove its Seattle office to 1407 Alaska building.

The Olympic Power Co., Port Angeles, Washington, is installing a 500-kw. synchronous condenser at its Bremerton substation.

Catalogues Received

Holt Mfg. Co., Stockton, California. 'Caterpillar Times,' August, 1914.

General Electric Co., Schnectady, N. Y. Bulletin No. 48014. Mine Hoist Equipment. Illustrated.

Beaudry & Co., Inc., 141 Milk street, Boston, Mass. Beaudry Power Hammers. Illustrated catalogue.

American Well Works, Aurora, Illinois. Bulletin 137, "American" Centrifugal Pumps. Illustrated.

Lewis M. Ellison, 6238 Princeton Ave., Chicago, Illinois. Ellison power plant instruments. Illustrated.

General Electric Co., Schenectady, N. Y. Bulletin No. 46390. Thomson Direct Current Test Meter, Type C-B, 5.

Consolidated Tramway Co., 61 Broadway, New York. Illustrated catalogue on Lawson loop-line tramways.

The Van Dorn Electric Tool Co., Cleveland, Ohio. Illustrated folder on Van Dorn portable electric drills.

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